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THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXXIII. No. 1.

APRIL, 1926.

NOTES FOR THE MONTH

State-aided Drainage Improvement Scheme

THE conditions on which the sum of £1,000,000 is to be made available over a period of five years, in accordance with the Government's Agricultural Policy for the purpose of aiding drainage schemes for the improvement of agricultural land, are announced in a circular letter which is being issued to all Drainage Authorities in England and Wales. The financial facilities afforded under this programme, which will operate as from April 1, 1926, are to be extended only to approved schemes submitted and carried out by statutorily constituted Drainage Authorities, and, generally speaking, grants will be limited to an amount not exceeding one-third of the final net cost of the work. In exceptional cases, however, the Ministry has authority in certain circumstances to provide up to one-half of the cost of the work from State Funds.

It is not the intention to impose any strict or arbitrary definition as to the type of work which will be accepted as eligible for assistance. Any comprehensive drainage proposals designed to confer a direct benefit on agricultural land, or new operations for the adequate safeguarding of important works carried out in previous years, will be open for consideration, although the Ministry reserves the right to refuse a grant in the case of any such application should it consider such a course desirable. Applications, however, for grants in aid of such works of maintenance as Drainage Authorities should normally carry out without State assistance will, in no circumstances, be entertained.

Land drainage work carried out with financial assistance from the State has hitherto been confined, almost exclusively, to comparatively small schemes designed primarily in the interests of unemployment relief among rural workers, and these schemes could be carried out only during the worst

part of the year from a drainage aspect, namely the winter months. Under this new proposal one great advantage will be that schemes can be carried out at the most suitable time of the year, with the most suitable type of labour, and if necessary the work can be spread over a period not exceeding five years.

Although these facilities are not intended essentially as a measure of Unemployment Relief, it is nevertheless anticipated that if the Authorities concerned take advantage of the scheme to any appreciable extent, work of a temporary nature, both skilled and unskilled, will be directly provided for a considerable number of men who might otherwise be unemployed. Further, although the conditions on which advances will be made are, *mutatis mutandis*, much on the same lines as those in force in connection with the Unemployment Relief schemes financed partly by the Ministry, there is one new feature of importance. It is almost inevitable that a considerable amount of new plant such as engines, pumps, piling and dredgers, will be required, and it is expressly stipulated that the Ministry's written approval must be obtained before orders are placed for any plant or materials of other than British manufacture. The new schemes are, therefore, likely to afford additional work in some of the depressed trades.

Agricultural Statistics, 1925

THE Ministry's Annual Report on the production of crops in 1925 will be issued in a few days. The report compares the yields of crops in 1925 with the average yields during the first fifteen years of the present century. The production of sugar beet and the conditions affecting this crop are discussed at length. A summary is included showing the extent of the information published by the Ministry throughout the year as to agricultural conditions and crop prospects, and it is shown that information as to probable yields is available to farmers before the great bulk of the year's crops are ready for sale. The tables attached to the report contain statistics of the yields per acre of the chief crops in each county of England and Wales.

The Report, which forms Part II of the Agricultural Statistics of England and Wales, 1925, may be obtained from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 6d. net, or 6½d. post free.

Young Farmers' Clubs

INTEREST in the Young Farmers' Club Movement is growing rapidly. Already forty-one counties have taken up the scheme and clubs to the number of forty-five have been successfully formed in twenty counties, with a membership to date of 1,312. Negotiations are in progress in 124 centres to start new clubs. The County of East Sussex has published the first number of the "Boys' and Girls' Poultry Club Journal" for its 370 members, and Mr. E. S. Sharpe, the Poultry Instructor for the county, who is editing the Journal, is to be congratulated on its appearance.

Through the courtesy of the Council of the Sussex County Agricultural Society the International Dairy Cow Judging Contest between teams representing the Young Farmers' Calf Clubs of the United States of America and England will take place at 2 p.m. on July 14, at the Sussex County Show at Eastbourne.

In Scotland Young Farmers' Clubs have been formed in Caithness, Orkney, Sutherland and Ross and Cromarty with a membership of eighty-five.

It is of interest to note that the existing clubs deal in a practical, interesting, commercial and up-to-date way with the following subjects: Beef and dairy calves, pigs, poultry, bees, rabbits (wool, fur and flesh), field crops, and experiments with artificial manures, horticulture, and intensive market gardening, simple cost accounting and management, public speaking and debating. The clubs are proving to be assets of great value in both urban and rural life.

Wheat-Breeding Investigations

THE Ministry has now published Research Monograph No. 4, entitled "Wheat-Breeding Investigations at the Plant Breeding Institute, Cambridge," by Professor Sir R. H. Biffen, F.R.S., and F. L. Engledow, M.A.* This monograph forms a progress report of unusual interest and importance, and places on record valuable additions to genetic knowledge. Amongst the topics dealt with are the following: The advantages of English Wheat-growing conditions; Mendelian heredity; linkage; chromosomes; forms used for

*Research Monograph No. 4, pp. 114, 30 illustrations. Obtainable from the Ministry, Price 2s. 6d. (Paper boards, 3s. 3d. Cloth 4s.) Post free.

crossing; general methods of breeding and the propagation of hybrids; the yield problem; straw; lodging; rusts and the breeding of disease-resisting forms; breeding for quality; the work of the Home-Grown Wheat Committee; effect of soil on quality; effect of manuring; tests for "strength"; the introduction of the Yeoman Wheats.

Professor Biffen is of opinion that wheat-growing is far from being a dying industry in this country, and that the crop will be grown in the immediate future on an increasing scale and with some profit to its producers. The one outstanding and encouraging fact is that England is in some important respects extraordinarily well suited for wheat cultivation. Our climatic conditions allow the long growing period which is so conducive to heavy cropping—the English output per acre is at least double the average of that of the exporting countries of the Old and New Worlds—drought is never responsible for loss here, frosts do no appreciable damage, and disastrous epidemics of disease are unknown.

The English wheat-grower's problem is to improve on forms which already in respect of everything except quality are fairly, if not very, satisfactory. The yield problem is of the first order of difficulty. Since 1883 there has been no noteworthy increase in the average yield of thirty-two bushels per acre, and present methods are likely to produce new varieties which outyield the old ones by 3-5 per cent. only. To measure such increases—which though small are of great economic importance—very accurate methods of yield testing are necessary, and what is known as the "chess-board" method is described and advocated.

The chapters dealing with the problem of breeding for quality tell the story of the production and distribution of the new variety Yeoman, a cross between Browick and Red Fife. This variety is not only incomparably superior in quality to ordinary English wheats, but compares favourably in yield with others generally cultivated. The reports of the judges at the annual Bakers' Exhibition leave no doubt that since the introduction of Yeoman wheat there has been a clearly marked improvement in the "all-English" loaf.

Professor Biffen and his staff are now tackling the problem of combining the best features of Yeoman with those of some of the stiff-strawed, yellow-rust resisting forms, and incidentally accumulating the material for an investigation as to the possibility of breeding wheats for special conditions and particular districts.

Wool Marketing

JUDGED from the standpoint of total value the home wool clip is not one of the important products of British farms, being valued roughly at £6,000,000 for the year 1924. Moreover, home-grown wool is usually only a by-product in the production of mutton and lamb. Nevertheless, in all efficient industries, by-products receive as much attention as the main output and it is clearly desirable that the methods of marketing wool should be kept up to date.

Wool was one of the few commodities which were not covered by the activities of the Linlithgow Committee, and it is probably true to say that no exhaustive examination of the subject of wool marketing in all its bearings has hitherto been published. Early attention was, therefore, paid to wool in the investigations now being carried out by the Ministry into the methods of marketing agricultural produce in England and Wales. The results have now been issued as No. 7 of the well-known Economic Series of publications, and the volume is one which will repay careful study.*

There has been a general decline in the sheep population of England and Wales over a period of years and, in so far as this is due to industrial expansion, it is likely to continue. Apart from this downward trend of production, considerable annual fluctuations occur, due to the incidence of disease, while seasonal influences such as a shortage of feeding stuffs, a bad lambing season, or failure of the turnip crop, also affect the marketing unit. Moreover, there are wide variations in quality of wool, each fleece, in itself, producing several qualities. It should be noted, too, that the division of British breeds into the main classes of Long Wool, Down and Mountain, or even into from thirty to thirty-five main types, is no measure of variation in quality. Further, the demand for early maturity and small joints, the influence of climate, soil and type of farm, are shown in a bewildering variety of cross-breds, half-breds, long-crosses, short crosses and plain mongrels. This can best be seen in the catalogues of wool sales, and arises from the desire to produce good mutton rather than good wool. These are characteristics of English sheep farming that the wool marketing machine cannot control and must accept. There are, however, some directions in which an improvement in wool might be possible

* Report on Wool Marketing (Economic Series No. 7). From His Majesty's Stationery Office, Price 1s. 6d., Post free, 1s. 7½d.

without sacrificing the mutton qualities of the sheep, and research work in these directions is still in progress.

The demand for English wool comes mainly from buyers who require wool of a special kind for a particular manufacturing purpose, but some 60 million lb. were exported in 1923, and the export trade appears to be increasing. The largest foreign demand is for the appreciable quantities of straight clips produced on the large hill-farms. If the export trade continues to increase, it should receive close attention from a marketing standpoint, as the methods of preparation and sale appropriate to a home market are often inappropriate to a foreign market calling for large quantities of standardised produce. In considering the present methods of preparing wool for marketing, the Report indicates a number of ways in which improvement can be effected—principally in the direction of using suitable dips and marking material which will not injure or stain the fibres, in clagging, washing and shearing, in the classification of the clip, and in the methods of packing and storing the wool.

The functions and significance of the various types of buyers, the distribution of country auction sales and the factors that make for their success, the position of the central wool markets in London, Bradford and elsewhere, the operations of what may be termed the "continuous market" for wool once it passes into the hands of the two main classes of middlemen in the woollen and worsted trade, namely, the wool merchant and the merchant topmaker, and the wider aspects of the trade, are successively examined in the Report in an interesting and informative way. The methods at present adopted in this country for marketing wool co-operatively; the difficulties of co-operative development and the management problems involved are also analysed in some detail. Of particular interest is the plea for the better organisation of country auctions. There are too many auctions in some districts and too few in others, and in face of vested interests wide readjustments are not likely to be easily made. The representative associations of farmers, wool-buyers and auctioneers should therefore, it is suggested, exercise more control over auction sales than is the case at present.

As the Report points out, wool marketing has its own special difficulties, but the economic distance from producer to consumer is comparatively short and this, of itself, should facilitate organisation and improvement of marketing technique.

Agricultural Index Number

MANY descriptions of agricultural produce were cheaper on the average in February than in the previous month, and as most agricultural commodities became dearer between January and February, 1911-13, the index number showed a sharp fall of 5 points. The general level of prices was 53 per cent. above pre-war, the same as in each of the last three months of 1925. As compared with a year earlier agricultural produce was on the average about 8 per cent. cheaper, the index figure in February, 1925, being 67 per cent. above pre-war.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921 :—

Month	Percentage increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	183	75	68	61	70	58
February	167	79	63	61	67	53
March	150	77	59	57	65	—
April	149	70	54	53	58	—
May	119	71	54	56	57	—
June	112	68	51	58	55	—
July	112	72	53	52	51	—
August	131	67	54	59	56	—
September	116	57	56	60	57	—
October	86	59	51	63	53	—
November	79	62	53	64	53	—
December	76	59	56	63	53	—

Grain.—All classes of grain were cheaper than in January, especially barley and wheat, which were 11d. and 5d. per cwt. respectively lower on the month. Wheat, at an average of 11s. 10d. per cwt., was 60 per cent. dearer than in February, 1911-13, but barley at 9s. 7d. per cwt. was only 19 per cent. dearer, and, with the exception of hay, was relatively the cheapest of any agricultural produce. Oats at 9s. per cwt. were 3d. per cwt. cheaper on the month, and the index number fall 8 points to only 27 per cent. above pre-war. As compared with a year ago wheat was 1s. 9d., barley 3s. 3d., and oats 1s. 1d. per cwt. cheaper.

Live Stock.—Fat cattle realised about 1s. per live cwt. less

than in the previous month, and as a slight advance occurred in the base years the index number fell 5 points to 47 per cent. above 1911-13. Fat sheep were ½d. per lb. cheaper than in January, and as prices rose sharply between January and February in the basic years, the index number records a drop of 13 points. Fat pigs were practically unchanged in price as compared with January, but owing to increases occurring in 1911-13 the index figures for both baconers and porkers were reduced 5 points, but even so fat pigs were relatively very dear at 89 per cent. above pre-war prices. This is the first check in the rise in the index numbers for fat pigs since July, 1925. As compared with the corresponding month in 1925, fat pigs were about 2s. dearer per 14 lbs. stone dead-weight, and fat cattle and sheep cheaper by 1s. 9d. per live cwt. and 4d. per lb. dead-weight respectively. All classes of store stock except dairy cattle, advanced in value, and store pigs were comparatively very dear at appreciably more than double the pre-war price. Dairy cows declined 10s. per head on the month and were 40 per cent. above 1911-13.

Dairy and Poultry Produce.—Milk again averaged 1s. 5⅝d. per gallon and the index number was unaltered at 74 per cent. above 1911-13, which was 10 points lower than in February, 1925. Butter was 1¼d. per lb. cheaper on the month and the index number fell 6 points to 47 per cent. above pre-war. Cheese was again unchanged but, with the base prices showing a rise, a reduction of 4 points occurred in the index number. Butter was over 2d. per lb. cheaper than a year ago, while cheese was 2½d. per lb. dearer. Eggs were reduced nearly 3d. per dozen, but as this reduction was relatively less than in 1911-13, the index figure showed an increase of 2 points to 72 per cent. above pre-war.

Other Commodities.—Potatoes were 2s. 6d. per ton cheaper than in January and the index number fell from 53 to 49 per cent. above 1911-13. Other vegetables averaged 86 per cent. above pre-war, a reduction of 13 points on the month. Carrots and celery were relatively very dear, the former being about 2½ times and the latter double the pre-war price. Brussels sprouts and onions declined in value and sold at about 80 and 35 per cent. respectively above 1911-13, while cabbage was dearer at 70 per cent. above pre-war prices. Hay prices advanced 1s. per ton on the month, but the index number was again unchanged at 4 per cent. above pre-war price.

FOOT-AND-MOUTH DISEASE RESTRICTIONS: THE 15-MILE AREA

A number of criticisms have recently been directed against the Ministry's practice, when an outbreak of foot-and-mouth disease occurs, of scheduling an area with a 15-mile radius from the premises as an "infected area" within which all movements of stock are restricted. In some of these criticisms it has been contended that a "5-mile" radius, and in others only a "2-mile" radius, would be a sufficient safeguard against the spread of infection.

The "15-mile" area was considered by the Departmental Committees of 1912, 1922 and 1924, and all these Committees approved the procedure. In paragraph 145 of their Report, (Cmd. 1784), dated December 7, 1922, the Committee of that year stated :—

> "We do not consider that it would be desirable to reduce the size of the 15-mile radius standstill area."

Again in paragraph 152 the Committee state :—

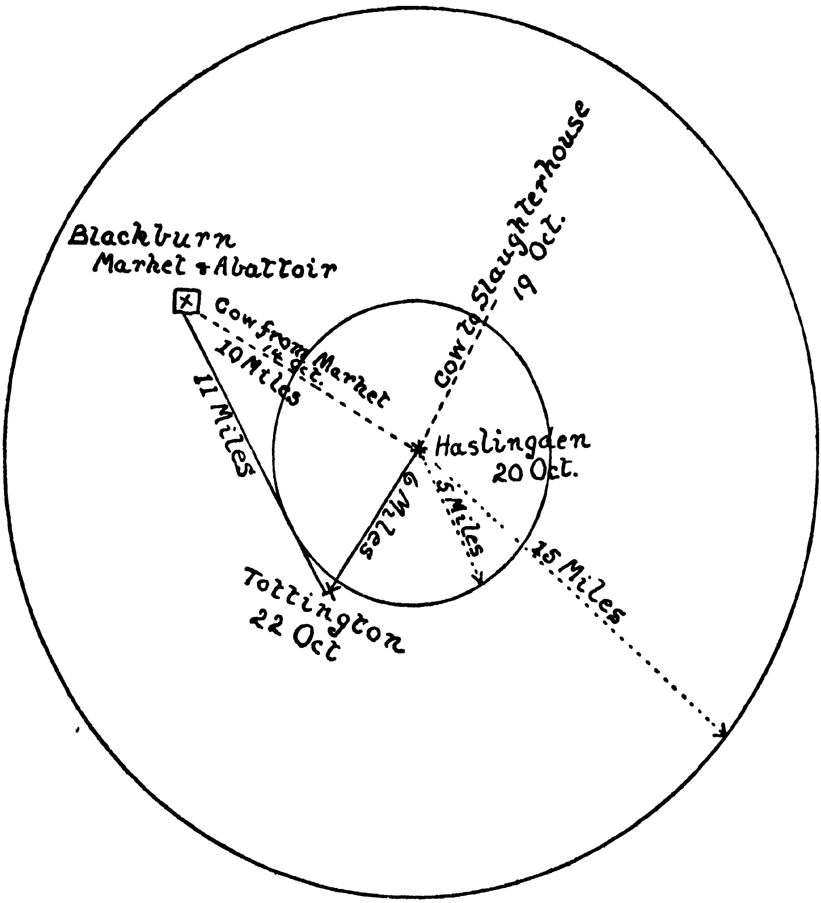
> "The restrictions appear to call for little further comment, and we think that the experience of this outbreak has provided abundant testimony as to their effectiveness."

The Departmental Committee of 1924, in paragraphs 89 and 90 of their Report (Cmd. 2350), of February 2, 1925, say :—

> "The main point of criticism has been the size of the area. . . . We do not think that the radius can safely be reduced at the outset. It has been claimed that the existing area is too large to permit of its effective control, but we have received no direct evidence in support of this claim. . . . An area with a radius of fifteen miles may seem unnecessarily large in dealing with a primary or single farm outbreak, but it has to be remembered that before the first symptoms of the disease were noticed and any precautions taken the animals were in a highly infective stage for about forty-eight hours. It is essential, therefore, that until all inquiries as to origin and possible spread of disease before notification have been completed, all animals which may reasonably be regarded as having been exposed to contagion should be subject to some form of control. We are unable, therefore, to recommend any

reduction in the size of the area to which restrictions are applied in the first instance."

The experience of the Ministry over many years has proved beyond question the wisdom of the "15-mile" area. The following diagrams, illustrating actual recent experiences, clearly demonstrate the necessity for declaring such an area in the first instance on the confirmation of an initial outbreak.

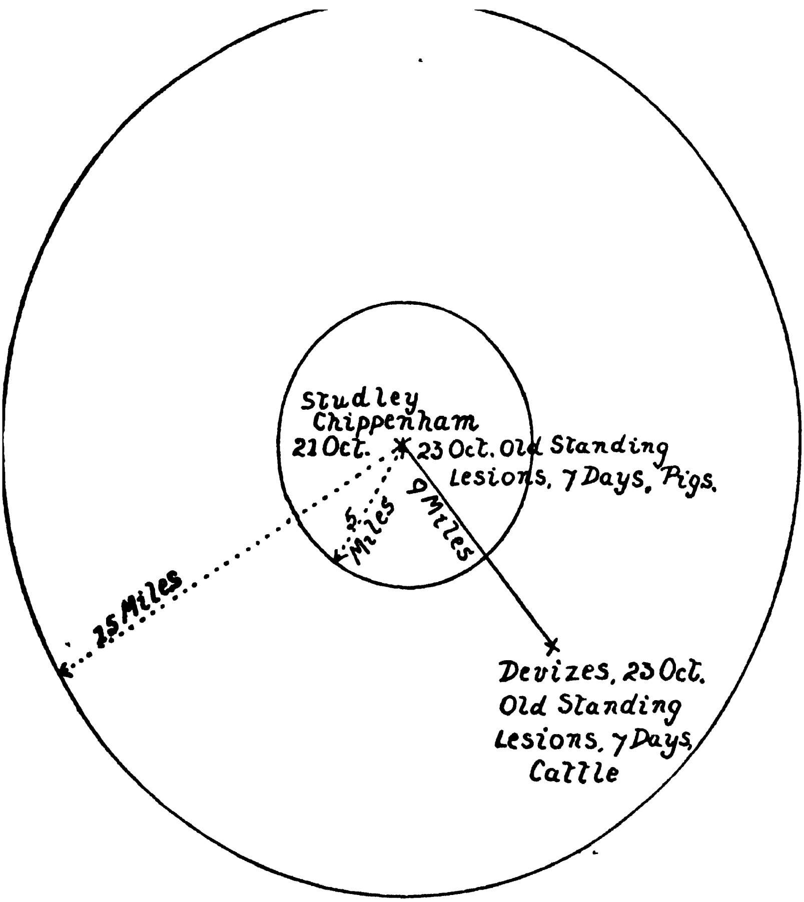


Case No. 1.—Lancashire (Blackburn district), October, 1925.

In this case disease was confirmed at Haslingden in a disease-free district on October 20. The affected cattle had been on the premises for some considerable time and the origin was not at once ascertainable.

On October 22 disease appeared at Tottington in cattle purchased at Blackburn Market of October 14, and on the same date at Blackburn Public Abattoirs adjoining the

market. For two days after the discovery of disease at Haslingden the Ministry was without evidence that Blackburn Market had been infected. If the area had been fixed at one of five miles radius Blackburn Market and a large number of consequential outbreaks among animals which had been exposed there would not have been included. Thus, the large number of infected cattle which left Blackburn Market for destinations more than five miles from the market would have had freedom of movement for at least two days and might have spread disease widely.

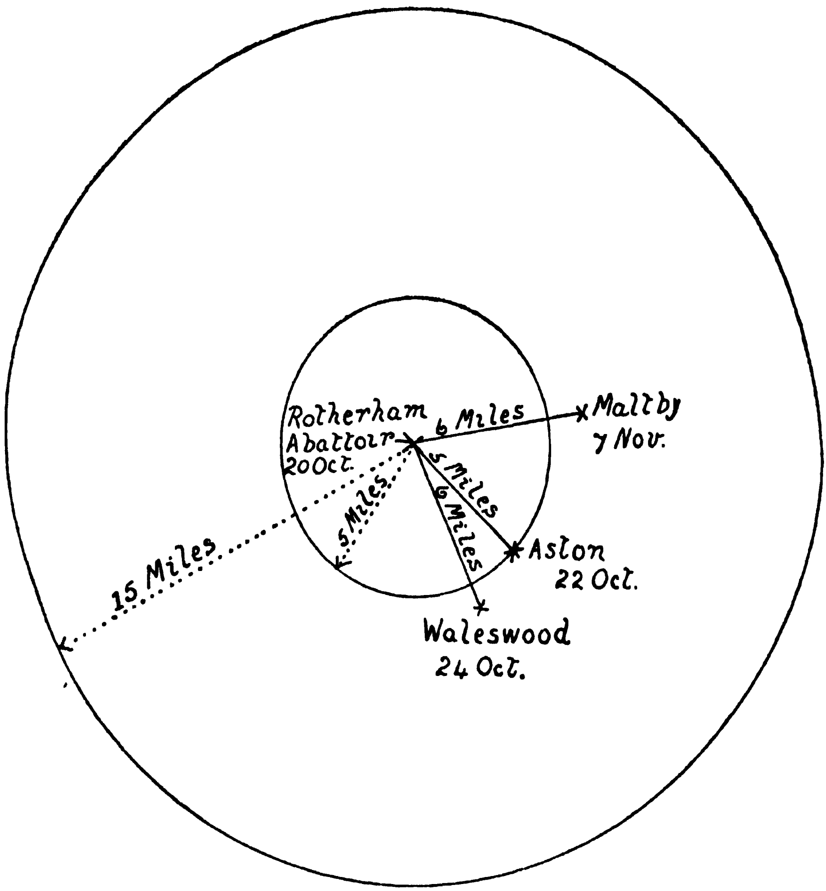


Case No. 2.—Wiltshire (Chippenham), October, 1925.

In this instance the disease was confirmed in a free district at Studley, near Chippenham, on October 21. On October 23 disease was confirmed in pigs at a farm near Studley, the

lesions being found to be seven days old. On the same date disease was also confirmed at Devizes, about nine miles south-east of the original case. In this case also disease was of old standing.

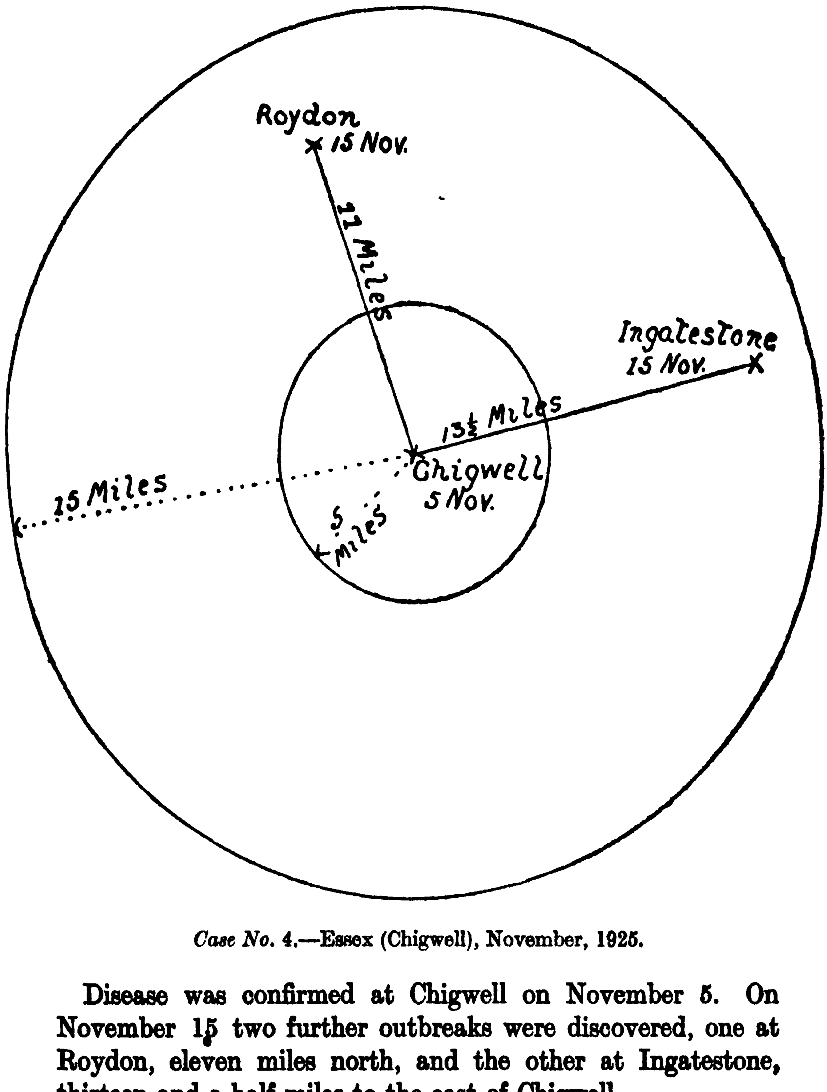
Thus the fifteen-mile area on October 21 stopped the movement of animals round the Devizes outbreak nine miles distant which was not discovered until two days later.



Case No. 3.—Yorks, West Riding (Rotherham), October, 1925.

Disease was confirmed at the Rotherham Public Abattoirs in a free district on October 20. On October 23 disease was discovered on the premises of a butcher in Rotherham, from which it was concluded that infection had been introduced into the abattoir. Sales by this butcher through a dealer

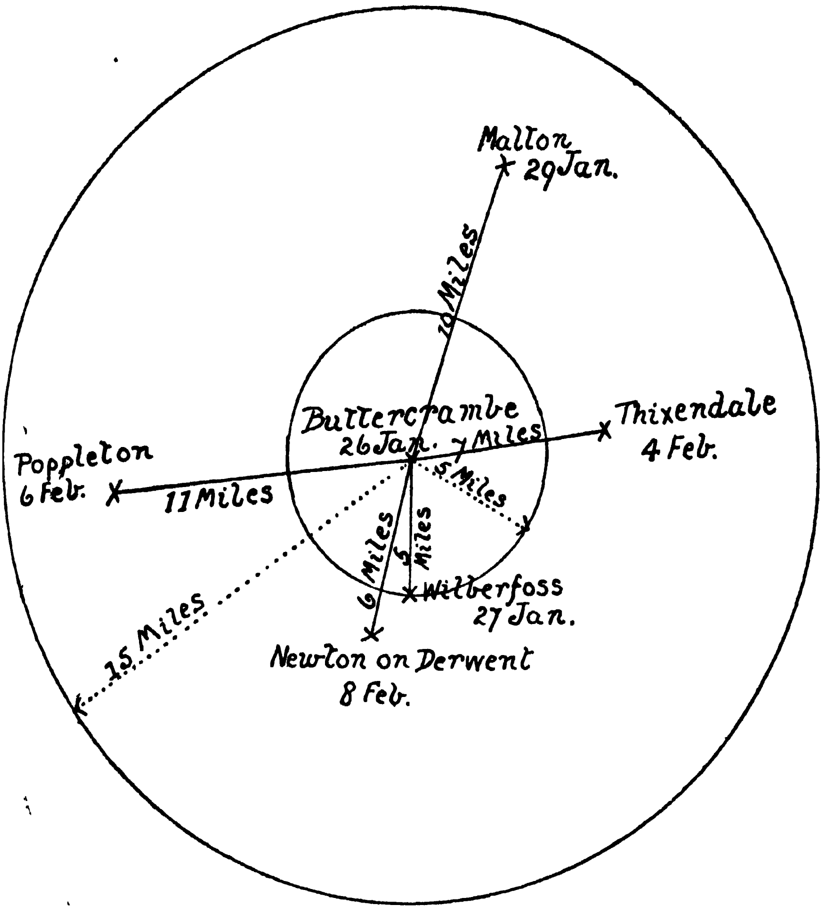
produced outbreaks at Aston on October 22, and at Waleswood on October 24, also an outbreak was confirmed at Maltby on November 7. These latter outbreaks all occurred at distances greater than five miles from the Rotherham case, but were all included within the fifteen-mile area. It should be noted that one of them was not discovered for seventeen days.



Case No. 4.—Essex (Chigwell), November, 1925.

Disease was confirmed at Chigwell on November 5. On November 15 two further outbreaks were discovered, one at Roydon, eleven miles north, and the other at Ingatestone, thirteen and a-half miles to the east of Chigwell.

An area of either five or even ten miles radius would have failed to enclose these two subsequent outbreaks, which occurred ten days after the original case.



Case No. 5.—Yorks, North Riding, January, 1926.

Disease was confirmed at Buttercrambe on January 26 in a free district. Subsequent outbreaks occurred as follows :—

Wilberfoss	January 27 ;	five miles south.
Malton ..	January 29 ;	ten miles north.
Thixendale ..	February 4 ;	seven miles east.
Poppleton ..	February 6 ;	eleven miles west.
Newton-on-Derwent	February 8 ;	six miles south.

The movement of stock from the neighbourhood of these subsequent outbreaks, the last of which did not occur until thirteen days from the initial case, was brought under control by the original fifteen-mile area. Neither an area of five miles radius nor even one of ten miles would have sufficed to bring all these premises under control.

Many other instances of the above character could be quoted, if necessary, but it is thought that these are amply sufficient to justify the continuance of the Ministry's present

procedure. It should be added that it is now the practice of the Ministry to reduce the area to one of five miles in simple cases after the lapse of fourteen days from the date of the outbreak, instead of twenty-one days as formerly.

Finally, the effect on the export trade in British pedigree stock of any proposal to reduce the present restrictions should not be overlooked. The Governments of the Dominions and of certain foreign countries with whom there is a valuable export trade in British pedigree stock are undoubtedly influenced in framing their regulations for the admission of such stock by the fact that the Ministry takes stringent measures to prevent the spread of infection from known centres of disease and also to include as far as practicable any unknown centres. The substitution for the initial "fifteen-mile" area of a smaller area, such as one of five miles, would very materially weaken the safeguards afforded by these measures and almost certainly result in adding still further to the restrictions which the Dominions and foreign countries are obliged to impose on the importation of British stock when disease is prevalent in Great Britain.

SEED WHEAT IN THE EASTERN COUNTIES

In order to obtain information as to the quality of seed wheat sown in the Eastern Counties during the past autumn, the Ministry arranged for one of its inspectors to visit a number of farms in Cambridgeshire, West Suffolk, and Essex for the purpose of drawing samples of seeds about to be drilled. It was intended to obtain 500 samples, but owing to various circumstances it was found impossible to secure more than 107. The result of the investigation of these samples brings out some interesting points, although the number of samples taken being smaller than was considered desirable the information obtained is by so much lacking in significance.

Varieties.—The varieties most frequently met with were Squareheads Master" (24 samples), "Victor" (17 samples), "Yeoman" (12 samples), "Little Joss" (13 samples), "Yeoman II" (7 samples), and "Red Standard" (7 samples). Other varieties included "Iron," "Rivetts," "Setter," "Cambridge Browick," "Harvester," "Rector," "Wilhelmina," "Marsters A1," "Bacton Champion," "Yeoman King," "Brookers Standup," "Stormproof," "Million III," and "Red Standup." Of the "Squareheads Master," 12

samples were obtained in Cambridgeshire, 8 in Essex, and 4 in West Suffolk; of the "Victor," 2 samples were obtained in Cambridgeshire, 9 in Essex, and 6 in West Suffolk; of the "Yeoman" and "Yeoman II," 2 samples came from Cambridgeshire, 13 from Essex, and 4 from West Suffolk; and of the "Little Joss," 10 samples were from Cambridgeshire and 3 from Essex.

Source of Supply.—Inquiry as to the source of the seed showed that in 14 cases it was bought from a seedsman or merchant, in 7 cases it was purchased from a neighbouring farmer, and in 86 cases it was home-saved seed. The somewhat striking preponderance in the number of cases where home-saved seed was being used is probably partly due to the fact that, the price of wheat in the autumn being low, farmers were discouraged from purchasing seed at a relatively high price. In many cases it was found that farmers had bought a small quantity of high-quality seed for growing on in order to produce a stock to plant the following year.

Germination and Purity.—All the samples obtained were forwarded to the Official Seed Testing Station for testing. The results of the tests showed that in purity 27 samples were over 99·5 per cent., 69 were between 98 and 99·4 per cent., and 11 were lower than 98 per cent. Fifty-four samples contained seeds of other plants, either other cereals or weed seeds; in 2 samples Ergot (*Claviceps purpurea*) was present, and in one sample Ear Cockle (*Tylenchus scandens*) occurred. In germination, 71 samples were 98 per cent. or over, 21 fell between 95 and 97 per cent., 9 between 90 and 94 per cent., and 6 were lower than 90 per cent. Although the tests showed that the samples were on the whole of high purity and germination, a large percentage of small and partly shrivelled grains were present in many cases. These grains germinated in the course of an ordinary test, but it is improbable that they would survive the hardship of normal field conditions. This points to the need of a critical examination of samples of seed wheat apart from the consideration of the particulars as to germination and purity which are obtained as a result of an ordinary test.

Bunt.—A further examination of the samples for the purpose of discovering the presence of bunt revealed a somewhat unsatisfactory state of affairs. Of the 107 samples, 29 contained bunt visible to the naked eye and 71 were found to be "bunted" when examined under the microscope. This left only 7 samples actually free from this disease. As is no doubt generally known, the Official Seed Testing Station always

notes on its reports cases where bunt is found to be present by a naked eye examination. Arrangements have now been made by the station to undertake a special microscopical examination of samples of seed wheats for bunt for a fee of 2s. a sample. Information with regard to the treatment for bunt before sowing was obtainable only in 73 cases. These included the use of sulphate of copper in 43 cases, preparatory dressings in 25 cases, and formalin in 4 cases. It was not possible to determine the degree of infection of the crops. This might have been only slight, but in any case the high proportion of samples which were found to be "bunted" indicates that the treatment to which they were subjected before planting was not satisfactory. Owing to the apparent prevalence of bunt, it may be desirable at this stage to remind growers that the Ministry's leaflet with regard to this disease can be obtained (single copies free of charge) on application to 10 Whitehall Place, S.W. 1.

Rate and Date of Sowing.—The quantity of seed sown per acre varied from 1½ to 3¼ bushels. In general, it appeared that the later the sowing took place the greater was the amount of seed used.

The wide divergence in the dates of sowing was very striking. Even within restricted areas and on the same type of soil, there was sometimes as much as eight weeks' difference in this respect. The reasons given for the late sowings were various, but chief amongst these was the difficulty in getting the farmer's own corn thrashed. There is not a large supply of thrashing machines in the corn-growing areas, and the demand for them varies with the fluctuations in the corn market. For instance, during the last autumn large quantities of wheat and barley were thrashed for marketing in the hope of securing a good price early in the season. The result of this was that thrashing machines were required to stay longer on the farms—perhaps three or four days at one farm—and consequently fewer farms were visited. For the same reason very little corn was thrashed early in the season for seed purposes.

Another difficulty is the shortage of men who are competent to manage thrashing machine sets. One machine owner stated that he had to give up five machines during the war, and since then he had been unable to take on any new machines because of the difficulty in obtaining men who would do satisfactory work without constant and even skilled supervision. Other reasons given for late sowings were that the

protracted harvest in many cases prevented the preparation of the autumn bed, and that the prospect of obtaining high prices for autumn barleys caused many farmers to concentrate on sowing barley during the last week of September and beginning of October, the sowing of wheat being further delayed.

Cleaning Home-grown Corn for Seed.—In cleaning his corn for seed purposes, the farmer does one or both of two things. He has it dressed as hard as possible by the thrashing machine, and he uses an ordinary winnowing machine. Although in some cases these methods answer quite well, neither gives really first-class results. The rate at which the corn passes through the machine prevents a satisfactory result from being obtained by the wire screen on the machine, and effective blowing depends for its best result on a steady current of air, which is difficult to obtain on a hand machine. It is suggested that this difficulty, which is of considerable importance in its effect on the result of a crop, might be overcome either by groups of, say, twenty to thirty farmers co-operating in the provision and working of efficient cleaning machinery at the farm of one of their number, or at some other convenient centre, or the provision by thrashing machine owners, at a fixed charge, of efficient portable dressing plants which could be used at the same time as thrashing or as a separate process afterwards.

Supply of Pedigree Seed.—Much could be done in the way of improving the corn crops in this country if farmers were able to obtain adequate supplies of first-class pedigree seed at a lower price than is possible to-day. It is believed that this could be effected to some extent if groups of farmers were to arrange with one of their number to grow special crops of pedigree seed to meet their united requirements. The farmers in the group might agree to purchase their seed for the following year from the produce of the specially grown crop at a price sufficiently above ordinary market price to allow the grower a profit that would encourage him to take some extra trouble with the crop as regards roguing and general cultivation. The cleaning operations might also be carried out on a co-operative basis on the lines suggested in the preceding paragraph.

Failing the co-operation of groups of farmers in this way, there seems to be an excellent opening for individual action. Farmers who decide to produce high quality pedigree seed and to arrange for early thrashing and cleaning on their own

farms should have no difficulty in finding a remunerative market amongst their neighbours.

The Ministry proposes to arrange for a further and more comprehensive series of cereal samples to be taken from the drill during the forthcoming season, when it is hoped that additional data, capable of wider application, will be obtained.

NOTES ON SOME PERMANENT GRASS PLOTS ON THE UNIVERSITY FARM, READING

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ON one of the arable fields at the University College Farm, Reading, known as the "Hop Ground," a series of plots, each an eighth of an acre in area, were sown in August, 1906, with eight different mixtures of grasses and clovers (Table II below).

It was hoped to obtain data regarding the permanence or otherwise of the different species of plants used in these mixtures under the soil conditions prevailing on the farm, and to observe the changes in the botanical composition of the herbage of the several plots from year to year.

The soil, which is heavy, was carefully cultivated and brought into a fine state for sowing, after a bare fallow following two corn crops. Sowing was carried out in August, but owing to the dry season germination was delayed until September.

A crop of hay has been taken from the plots annually for nineteen years, the aftermath being grazed. During the first three years no manure was applied, but in 1910 the plots received 4 cwt. of basic super-phosphate and 2½ cwt. of kainit per acre. In 1912, a dressing of 4 cwt. of basic slag and 2½ cwt. of kainit was given, followed by 1 cwt. of nitrate of lime in 1913. In 1914, 125 lb. of nitrate of lime were applied, and since that date the plots have been given an annual application of 3 cwt. of slag and 2 cwt. of kainit in winter, followed by 1 cwt. of nitrate of lime per acre in spring; no farmyard manure has been given.

Seed Mixtures.—The mixtures of seeds sown are given in Table I, and the percentage of the ground covered by the

TABLE I.—SPECIES AND WEIGHT OF SEEDS PER ACRE.

	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Germination
(1) *Clovers.*	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	Per cent.
Perennial red clover ..	1	2½	1	12	1	12	3	8	3	8	..		..		2	0	99
Alsike	1	0	1	8	1	8	3	0	3	0	..		..		2	0	98
*White clover	1	6	2	0½	2	0½	4	1	4	1	2	0	4	0	2	0	99
(2) *Short-lived Grasses.*																	
Perennial rye grass ..	2	13	4	3½	8	7	4	3½	8	7	..		..		10	0	99
Timothy	1	3	1	12½	3	9	1	12½	3	9	1	0	2	0	2	0	100
(3) *Permanent Grasses.*																	
Cocksfoot	1	0	1	8	1	0	1	0		8	2	4	4	8	2	0	95
Meadow fescue	2	5	3	7½	2	5	2	5	1	2½	4	8	9	0	9	0	97
Meadow foxtail	1	14	2	13	1	14	1	14	1	7	2	4	4	8	3	0	86
Rough-stalked meadow grass		8		12		8		8		4	1	0	2	0	2	0	96
Smooth ,, ,,		8		12		8		8		4	1	0	2	0	..		95
Dogstail		11	1	0		11		11		5½	..		..		1	0	96
Hard fescue	1	0	1	8	1	1	1	1		8½	..		..		..		97
Festuca ovina (true) ..	..		..		..		..		..		..		..		1	0	95
Festuca rubra	..		..		..		..		..		..		..		3	0	95
Avena flavescens	..		..		..		..		..		..		..		1	0	88
Total lbs. per acre	15	6½	23	1	25	3½	24	8	27	0½	14	0	28	0	40	0	
Millions of seed per acre, about	9		13½		12½		13		15		10		20		20		

TABLE II.—CALCULATED PERCENTAGE OF GROUND COVERED BY THE CLOVERS AND GRASSES AT TIME OF SOWING.

	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
Clovers	—	20	20	40	40	—	—	—
Short-lived grasses ..	—	20	40	20	40	—	—	—
Permanent grasses ..	—	60	40	40	20	—	—	—

TABLE III.—WEIGHT OF HAY PER ACRE.

Year	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8
	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.
1907	44	52	61	54	65	50	43	43
1908	46	48	50	53	43	46	48	61
1909	53	59	45	45	50	40	37	39
1910	32	36	36	30	34	40	40	32
1911	40	46	45	44	54	42	56	38
1912	62	60	66	52	58	57	55	47
1913	56	54	61	50	45	43	47	44
1914	34	40	46	44	44	40	58	42
1915	31½	26	24	21½	20	24½	23	24
1920	34½	33	28	35	36	37	34½	36
1921	25¼	22¼	22¾	19¾	23¼	28	25½	27¾
1922	30	29	32	24¾	31	33¾	24¼	34
Total of 12 years ..	488¼	505¼	516¾	473	503¼	481¼	491¼	467¾
Average annual yield	40½	42	43	39½	42	40	41	39

grasses and clovers respectively stated in Table II; the annual yields of hay from the several plots during twelve years are given in Table III: annual weighings of the produce were discontinued during the war and after 1922, owing to cost, labour, and other difficulties.

On plot 2 was sown a mixture of grasses and clovers, which in the particular species, number of species and amount of seed I considered most suitable for this type of land in the Reading area. The amount of seed sown was about 23 lb. per acre, containing some 13½ millions of seeds. On plot 1 the same mixture was employed but the amount per acre was 25 per cent. less than on plot 2.

On plots 3, 4, and 5, exactly the same species of plants were used as on plots 1 and 2, but the relative proportions of the clovers, short-lived grasses and permanent grasses were varied in order to observe the effect of these variations

upon the permanence of the pasture as well as on the yield of hay and the general character of the turf or sward ultimately established.

Plots 6 and 7 were sown with a mixture consisting of six species of permanent grasses only, with the addition of white Dutch clover, plot 7 receiving 28 lb. per acre (20 millions of seeds), plot 6 half those amounts.

On plot 8 was sown a typical seedsman's mixture of 40 lb. per acre, such as was commonly recommended twenty or thirty years ago, and containing 20 millions of seeds.

Observations over the whole period of nineteen years since sowing have been made annually in June upon the species of grasses, clovers and miscellaneous plants present on the several plots, and their relative abundance as far as could be estimated by eye observations alone.

Notes on Species.—The following notes on the several species are of interest.

Red Clover.—The so-called perennial red clover was used; although abundant during the first two years on all the plots on which it was sown, it almost disappeared in the third year. A few isolated plants, however, are still found on many of the plots, more particularly on those on which the largest amounts of this species were originally sown.

Alsike Clover.—This clover lasted considerably longer than the red clover, being fairly abundant up to the ninth year after sowing; like red clover single plants are still found on several of the plots.

White Clover.—The ordinary Dutch variety of this plant was used. Although not now so conspicuous as in the early years it is still found in fair quantity on all the plots. In 1921, fifteen years after sowing, it was extremely abundant and flowered in great profusion, being stimulated by an application of lime in the previous season. Both cyanophoric and non-cyanophoric forms are now present. I feel no doubt that the non-cyanophoric forms are the Dutch variety and that they are descended from seeds sown in 1906. This variety appears to seed freely in some seasons, and probably the plants appearing in the later years are derived from self-sown seeds. The "permanence" of cultivated Dutch clover depends more upon self-sowing than does wild white clover.

Perennial Rye Grass is found on all the plots in great abundance, but in greatest amount on plots 3, 5 and 8 on which most seed was first sown, and in least quantity on

plots 6 and 7 where none was sown. It has become one of the dominant species on all the plots by means of its prolific seeding habit.

Timothy.—This has proved a permanent species on these plots, but is less abundant now than it was during the first ten years; the greatest number of plants still appear on those plots which received most seed when the plots were originally sown, and on plots 6 and 7 on which no rye grass was sown.

Cocksfoot.—Cocksfoot has diminished considerably on all the plots during the last few years; most plants are now seen on plot 8.

Meadow Fescue.—This grass has proved of exceptional interest. At Reading it is among the latest of grasses to flower, and in late May and early June when notes are first made on the plants present on the plots, the inflorescence is hidden in the leaf sheath and the species is easily overlooked, and reported as absent. A week or ten days later, however, and just before the plots are mown the inflorescence is well developed and readily seen. It is not now so conspicuous as in the first few years, but is still found on all the plots, more especially perhaps on 6 and 7.

Meadow Foxtail has maintained itself on all the plots and is most abundant upon 6 and 7 where most was sown.

The Meadow Grasses.—Of the two meadow grasses sown the rough-stalked species is by far the most frequent.

Crested Dogstail is found on all the plots, having extended itself by seeding to the two plots 6 and 7 on which no seed of this species was originally sown.

Hard Fescue and *Sheep's Fescue* have failed to establish themselves.

Red Fescue was sown on plot 8 and was common for the first nine or ten years on this plot; none was visible in 1925.

Golden Oat Grass.—This species, which is rare or quite absent from the district around the College Farm, has given remarkable results. It was included in the mixture sown on plot 8, and during the whole nineteen years has steadily maintained its hold on this plot. For ten or twelve years it was found only on this plot, but during the last six or seven years it has spread, doubtless by seeding, to several of the plots, but more especially to the adjoining plots 6 and 7.

Comparison with old pasturage.—Comparison of the herbage which has established itself on these plots, with that on the nearest old permanent pasture on Barn Field which has not

been under the plough within living memory, leads to important conclusions.

The grasses, clovers and miscellaneous species on this old pasture are :—

GRASSES

Very Abundant	*Abundant*
Meadow foxtail	Crested dogstail
Sweet vernal grass	Rough-stalked meadow grass

In smaller amount are, smooth-stalked meadow grass, soft brome grass, sheep's fescue, *Festuca Myurus*, and Yorkshire Fog, with a few plants of golden oat-grass.

CLOVERS

White clover abundant when the ground is treated with basic slag.

Yellow suckling is very abundant.

Red clover ; a few plants appear sporadically.

MISCELLANEOUS WEEDS

Sheep's sorrel	Ox-eye daisy
Bulbous Crowfoot	Common daisy
Narrow-leaved plantain	Yarrow
Luzula campestris	*Cerastium vulgatum*

Timothy grass and meadow fescue are entirely missing, and there is very little perennial rye grass and cocksfoot.

It is sometimes stated that the indigenous plants common to old grass land in any district soon appear and take a leading place on arable land sown down with seedsmen's mixtures, and that it matters, therefore, very little what species are used in these mixtures. That this is untrue is manifest at once when the botanical composition of the herbage of these plots is compared with that of the old pasture just mentioned.

With the exception of hard fescue, sheep's fescue, and red and Alsike clovers, all the species sown are still found on all the plots, and golden oat-grass chiefly on the only plot on which it was originally sown.

Sweet vernal grass, one of the dominant grasses of the neighbouring fields and a free seeder, is practically missing from the plots after nineteen years of opportunity to spread itself over them. Timothy, perennial rye grass, cocksfoot and meadow fescue not found on the old grassland near, or only as isolated plants, have not disappeared from these plots nor been

ousted by indigenous competitors, but have established themselves, perennial rye grass becoming a dominant species.

Moreover, common daisies, narrow-leaved plantain, buttercups, yarrow and *Luzula campestris*, weeds abundant on the permanent pasture, have not made their appearance on the plots.

Where due regard is paid to the suitability of the species to the land to be laid down to permanent pasture, and a proper balance is kept between the rapid growing short-lived species and the more lasting kinds, it may be safely asserted that for twenty years and probably for a much longer period, the grasses and clovers sown will establish themselves, and prevent others from usurping the land, provided that the pasture is adequately manured and properly managed.

In regard to the yield of hay from the different plots, Nos. 2 and 3 have given the greatest amount of hay over the period of nineteen years indicated in Table III ; the smallest yield has been produced by plot 8.

Summary and Conclusions.—(1) Good permanent pastures can be established on arable soils by sowing suitable mixtures of seeds of grasses and clovers.

(2) By adopting a properly balanced proportion between the short-lived and the more lasting species in the seeds mixture, a uniformly good yield of herbage can be assured from the beginning, and the usually diminished yield so commonly experienced in the third and fourth years after sowing can be avoided.

(3) All the species of plants sown are still found on the plots after nineteen years, though red and Alsike clovers, hard and sheep's fescues, and smooth-stalked meadow grass almost entirely disappeared after four to six years, and are now only represented by a few isolated plants.

The comparatively short-lived perennial rye grass spreads rapidly by means of self-sown seeds and has become a dominant species ; crested dogstail extends itself in a similar manner Cocksfoot, timothy, meadow foxtail, meadow fescue, rough-stalked meadow grass and golden oat grass have retained their hold on the land though meadow fescue and cocksfoot have diminished considerably during the last ten years.

(4) The oft repeated statement that whatever kinds of seeds are sown the plants derived from them become crowded out in a few years by indigenous plants of the district, is untrue for this centre ; after nineteen years the botanical composition of these plots is totally different from that of old pastures on the same farm.

(5) Weeds do not establish themselves on land sown with suitable mixtures of grasses and clovers and adequately manured and grazed. Daisies, buttercups, yarrow, narrow-leaved plantain, and sheep's sorrel, though common weeds on grassland near, have not appeared on the plots.

(6) There appears to be a tendency for all the plots to give approximately the same bulk of herbage after eighteen to twenty years, although the botanical composition of the plots remains distinct, the difference in this respect being dependent upon the kind and amount of seed originally sown.

(7) The weeds which have appeared on these plots are soft brome grass, Yorkshire fog, ox-eye daisy, dandelion, cat's ear (*Hypochaeris radicata*) and *Crepis taraxacifolia*, these being most frequent upon plot 8.

Thanks are due to Professor Pennington for the care he has bestowed on the management of the plots.

SUGAR BEET AT THE UNIVERSITY FARM, CAMBRIDGE

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Since the establishment of the Government Subsidy for the encouragement of sugar beet, this crop has been grown on the University Farm at Cambridge for the purpose of keeping touch with and assisting in the development of the industry. Two successful crops, yielding in 1924 nearly 15 tons of washed beet per acre, and in 1925, 12 tons, have been grown, and the following records have been obtained.

Influence of Subsoiling.—Subsoiling is generally recommended as an important part in the practice of growing sugar beet, though the necessity for this is disputed by Dowling.* There is at least a strong *prima facie* case for this practice in the Eastern Counties, where the depth of ploughing in recent years has generally been very shallow and where summer drought so frequently limits the yield of root and other crops. Accordingly, the larger part of the 3-acre field devoted to sugar beet in 1925 was subsoiled at the time of ploughing. The field in question was of a gravelly nature and overlies a subsoil of gravel and sand at a depth of three to four feet. It was ploughed six inches deep at the end of January, and subsoiled an additional three to four inches at the same time. The part unsubsoiled

*R. N. Dowling: *Sugar Beet from Field to Factory*, p. 19.

FIG. 1.—*Left.* Root system of sugar beet on unsubsoiled land. *Right.* Root system of sugar beet on subsoiled land.

FIG. 2.—Showing effect of Subsoiling on the shape of the Roots.
Top, Roots from subsoiled area
Bottom, Roots from unsubsoiled area

was ploughed six inches deep only. At the time when these operation were in progress the land was sufficiently dry to enable the subsoil plough to burst up the subsoil instead of cutting through it, a condition which is obviously very important for this operation. Though the subsoil was compact and tight it contained no obvious pan.

The crop was planted on May 8, and set out and singled in early June, care being taken that the work proceeded equally on the subsoiled and unsubsoiled parts. The season was very characteristic of the climate in the Eastern Counties, for a drought soon set in which was not finally dissipated till the fourth week in August, as the following schedule of rainfall indicates :—

May	1·96 inches	..	(·71 May 23)
June	0·35		
July	1·32		(·34 July 20)
August	2·15		(·58 August 23, ·34 August 24)
September	2·57		
October	3·07		

Droughty conditions prevailed therefore from May 24 until August 23 with only one fall, July 20, exceeding one-fifth of an inch. Both crops, subsoiled and unsubsoiled, started equally well and continued to progress until the land began to dry up and the crops to feel the pinch of drought in July, when it became obvious to the eye that the subsoiled beets were making better growth of foilage, and, later, better growth of root than the unsubsoiled, with the exception of the one row of beets growing on the unsubsoiled area and adjoining the subsoiled ground. The appearance of this row suggested that it belonged to the subsoiled area. Doubtless this appearance was due to the roots of the sugar beet in this row growing laterally through the soil into the subsoiled area adjoining. Subsequent examination of the root-growth proved this to be the fact, for, at the time of lifting, a trench two feet deep was cut at random across the line intersecting the division between the subsoiled and unsubsoiled areas. Adhering soil was washed away by a fine jet of water, as recommended by the Howards,* from a pair of adjoining beets, the one growing on subsoiled, the other on unsubsoiled ground. Fig. 1 is a photograph of the root exposure in the trench after washing away the soil. It shows the

* A. Howard, C.I.E., and Gabrielle L. C. Howard, M.A.: *Report of the Imperial Economic Botanists to the Government of India*, 1917-18, p. 17.

beet root on the right growing vertically downward into the subsoiled ground and forming a shapely root; whilst the root system of the beet on the left, growing over unsubsoiled land, is all verging in a more or less horizontal direction towards the subsoiled area on the right.

In the middle of August, the drought was so severe that, during one or two very hot days, growth came to a standstill and the foliage on both plots wilted and collapsed upon the surface of the ground during the heat of the day.

After the drought broke on August 23 the beets upon both areas recommenced active growth, those on the subsoiled area still showing to better advantage. Towards the end of September the beets on the subsoiled area, probably having exhausted all available nitrogen from the soil, began to ripen and their foliage to turn yellow, whilst the beets on the unsubsoiled area continued in vigorous growth with green foliage, and at the time when the plots were harvested the unsubsoiled beet gave the impression (falsely) of a better crop because thay had the greater growth of top.

On October 27, five comparable plots from each area were lifted, topped, and washed, the average weight of roots and tops being shown in Table I:—

TABLE I.*

	Subsoiled	*Not Subsoiled*
Weight of roots	13·1 tons	12·0 tons
Weight of tops	9·1 ,,	11·3 ,,

The table shows an advantage of 1·1 ton of washed beet in favour of the subsoiled area, and a disadvantage of 2·2 ton of beet tops.* If the time of lifting had been delayed till the end of November, doubtless the unsubsoiled beet would have made up some of the leeway. If, on the other hand, the field had been more fertile or more heavily manured, or the weighings had been made in early October, the advantage in favour of the subsoiled area would probably have been still further accentuated.

Yet another advantage was demonstrated in favour of the subsoiled area in the shape of the roots produced. Those grown on the subsoiled area were generally distinctly better shaped and produced a root system which was much less fanged than on the unsubsoiled area. The method of demonstration consisted in digging 100 roots at random from each area, cleaning the roots from dirt, and then arranging each set in order of merit according to shape. This was repeated on two occasions. In each case the subsoiled area gave about 75 per cent. of perfect roots, whereas the unsubsoiled area gave only 50 per cent.,

* The probable error in the case of the subsoiled plot is 0·4 of a ton, and in that of the unsubsoiled plot 0·6 of a ton.

and whilst the number of badly fanged roots on the unsubsoiled area amounted to about 15 per cent., those on the subsoiled area were negligible. The photograph, Fig. 2, illustrates these facts; 4 beets were taken from each of the 100 subsoiled and unsubsoiled roots after these had been arranged in order of merit for shape, the 13th, 38th, 63rd and 88th being taken in each case. The subsoiled roots are the 4 arranged at the top of the figure and the 4 unsubsoiled at the bottom. It will be noticed that 3 out of the 4 subsoiled are perfect roots, whilst 2 of the 4 unsubsoiled roots are more or less branched. The objection to such fanged roots is not only that more soil adheres to them so that cartage and railage are more costly, but in the factory the side rootlets get broken off and classed as tare and are lost to the grower.

The inference to be drawn from these observations would seem to be that, at any rate in a draughty season and when subsoiling is properly executed, the crop is enabled to obtain more moisture, and consequently to produce a larger crop, and in any case to produce roots which are better shaped and less wasteful in the factory. In addition to this, advantages are likely to accrue to succeeding crops in the rotation.

Influence of Date of Singling.—Another portion of the same field was laid out to demonstrate the importance of early singling. Three dates of singling were practised: the first on June 4-6, when the beet were very small, having no more than four leaves; the second on June 15-16, when the beets were well grown, but without obvious overcrowding; and the third on June 22, when the beets were obviously overcrowded. Five plots in each piece were marked out for lifting so that in any series the plots under comparison were situated as close as possible to each other. They were lifted, topped, washed, and weighed on November 8 and 9. Table II gives the average weight of roots and tops per acre in each case :—

TABLE II.

	Weight of roots	*Weight of tops*
Singled June 4-6	13·5 tons	9·7 tons
Do. June 15-16	12·9 „	9·5 „
Do. June 22	10·6 „	8·2 „

The demonstration shows an advantage of 0·6 tons of washed roots, and 0·2 tons of tops, in favour of singling at the earliest possible stage as compared with ten days later, and an advantage of 2·9 tons of washed roots, and 1·5 tons

of tops, as compared with seventeen days later when the plants were obviously overcrowded.* The value of early singling is of course well-known, but it cannot be too greatly emphasised in these early stages of the industry in this country.

Utilisation of the Tops.—After the sugar beet have been lifted and roughly freed from dirt, the tops are cut off and the roots sent to the sugar factory. The plane of section for topping, as defined by the factory, should be just below the lowest bud, formed in the axil of the lowest leaf. Any part of the crown left on the root above this plane is cut off during the sampling, weighed, and the percentage of such crown is assessed and treated as part of the tare. From the grower's point of view, therefore, it is important that the top be severed at the correct plane.

In order to ascertain what proportions of unnecessary crown were actually being sent in to the factory, a record of twelve truck loads handled at the Ely Beet Factory, was taken by Mr. G. F. Kingston, B.A., on November 27, and is shown in Table III, together with the records of six trucks sent in at different dates from the University Farm and tared in the ordinary way at the Factory.

TABLE III.—TARE FROM CERTAIN SAMPLES OF SUGAR BEET.

Sample No.			Percentage Tare of dirt	Percentage Tare of crown	Percentage Total Tare
1	from	Chatteris	2·0	0·0	2·0
2	,,	Prickwillow	14·0	1·1	15·1
3	,,	Soham	23·0	1·5	24·5
4	,,	Fordham	18·0	2·3	20·3
5	,,	Soham	13·0	2·4	15·4
6	,,	Soham	8·0	2·9	10·9
7	,,	Somersham	5·0	3·1	8·1
8	,,	Soham	5·0	4·1	9·1
9	,,	Soham	5·0	4·3	9·3
10	,,	Soham	16·0	5·7	21·7
11	,,	Chatteris	16·0	6·8	22·8
12	,,	Warboys	11·0	7·6	18·6
13	,,	Cambridge	6·0	2·0	8·0
14	,,	,,	10·0	4·0	14·0
15	,,	,,	10·0	4·0	14·0
16	,,	,,	8·0	2·0	10·0
17	,,	,,	11·0	4·0	15·0
18	,,	,,	12·0	2·0	14·0
Average of 18 samples			10·7	3·3	14·0

The first twelve samples in the table were taken from sugar beet produced in the fenland area round Ely, and

* The probable error is about 0·4 of a ton.

were grown on either fenland or "skirt"-land soils. The last six samples were grown on the University Farm, Sample No. 16 being grown upon a clay loam and the remainder upon a light gravel soil.

From the table it will be seen that the variation of dirt tare was between 2 per cent. from Sample No. 1 from Chatteris, to as high as 23 per cent. from Sample No. 3 from Soham. It is interesting to record that Sample No. 16, grown upon a heavy clay loam at Cambridge, only gave a tare of 8 per cent., though lifted in November when the land was sticky from frequent night frosts. This low percentage of dirt tare was due to careful treatment after lifting. These roots were for the most part lifted by handforks, since the ground was too sticky for the usual design of beet-lifter, but it is interesting to record that four rows which were left for purposes of demonstration with Maynard's new design of lifter, were pulled up from the sticky ground by this lifter with great success, and were left by it on top of the ground very much cleaner than those pulled by hand and fork. After being lifted the sugar beet, with tops still attached, were either stacked in small heaps or in long rows, in each case with the tops protecting the outside of the heap, and left for a week or ten days. At the end of this time and on a dry day the earth had weathered and easily "chingled" off when the roots were knocked together.

The percentage tare of crowns varies in the table between 0 per cent. in the case of Sample No. 1 from Chatteris, to 7·6 per cent. in Sample No. 12 from Warboys. The samples from the University Farm varied between 2 and 4 per cent.

In cases where the tops are simply ploughed into the ground as a green manure, the loss resulting from the unnecessary top sent in is not very great. It entails a little more cost for carting and transport and it results in a slightly lower return of percentage of sugar, because, although the crowns are cut off at the factory when estimating the tare of the crown, the sample for estimating the percentage of sugar is taken from the sugar beet roots after these have been washed, but without the crowns removed. Now the percentage of sugar in the crowns is less than in the roots, and therefore the percentage of sugar from the sample taken as above is lower than that in the root alone. A grower who sends in much crown loses on his sugar percentage.

If the tops can be utilised as feed for sheep, cattle, or pigs, then the loss entailed by sending to the factory unnecessary

crown is considerable; thus 7 per cent. of crown (as in Sample No. 12), if referred to a 10-ton crop, is equivalent to 14 cwt. per acre of sugar beet crown. This is shown, by comparing analyses of sugar beet crown with mangolds in Table IV, to be equivalent to about 30 cwt. of mangolds per acre.

TABLE IV.—Analyses of sugar beet
beet tops ensiled, a

	1. Crowns per cent.	2. Tops per cent.	3. Tops ensiled per cent.	4. Mangolds per cent.
Albuminoids ..	2·0	2·4	2·9	1·0
Carbohydrate ..	18·0	9·3	8·0	9·0
Ether extract ..	·2	·3	·3	·1
Fibre	1·4	2·5	2·5	·7
Ash	·8	4·0	4·8	·8
Water	77·6	81·6	81·5	88·4

Table IV gives the comparative analyses of (1) the crowns, which are cut off and classed as tare at the factory; (2) the tops as left on the field, the composition of which will vary according to the plane of section; (3) the same tops ensiled, and (4) an average sample of mangold. It will be noticed that the crowns contain approximately double the food constituents of mangolds, and constitute therefore a valuable food to any farmer who can feed them to stock. Since the factory places no value upon them it is most important to see that as little as possible unnecessary crown is left attached to the root when the tops are cut off. It is not impossible that some simple implement might be designed to sever the tops more accurately than the primitive chopper or sickle generally used, and if so would be in considerable request. The table also shows that the tops have a composition somewhat similar to that of a mangold root.

Feeding Sugar Beet Tops to Sheep.—Sugar beet tops may be folded with advantage to sheep, especially when fed in conjunction with some other feed. Three acres of such tops from a crop which yielded 11 tons of washed root have been fed to the University flock of 135 Suffolk ewes, lambing in January, between November 21 and December 18, a period of 27 days. At the time of lifting, in mid-November, the weight of tops amounted to about 8 tons per acre. This is equivalent to about 14 lb. per ewe per day, but of course the sheep did not clean all the leaves up completely, especially when cut off some time previously, though they ate with great relish the crowns and any root which had been accidentally missed. The ewes had a run on the grass and half

a pound of hay per head each day, and were folded upon the tops at night, thus the tops constituted approximately half their daily food. During the period the ewes obviously improved in condition and the nature of the dung indicated that digestion was all that could be desired. One caution should, however, be given in respect of such folding of sugar beet tops, namely, that the tops be not allowed to become too much dirtied with soil on sandy land, lest this be consumed in too large a quantity and collect in the stomachs of the sheep. This has been known to cause death. If a little care is exercised at the time of topping and carting such danger need not be great.

Sugar Beet Top Silage.—On the Continent sugar beet tops are largely made into silage in clamps, but this silage is often very sour. On a small scale, in 1924, two cartloads of beet tops were successfully made into silage in a small experimental silo, and the resulting product was readily consumed by cattle. A similar quantity of beet tops, mixed with chaffed straw, were also ensiled for the purpose of making a drier silage, and resulted in a much less satisfactory product. It was very sour and unpalatable. Further observations in the making of beet top silage are in progress.

THE BEE RESEARCH INSTITUTE AT ROTHAMSTED

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IN this country, bee-keeping was possibly more general in the old skep days than at present, but it must be admitted that, on the whole, the bee-keeper of to-day takes a more lively and intelligent interest in his bees than did his predecessor. The movable comb hive has had much to do with this change, while the diseases of bees — Foulbrood, and in more recent years the "Isle of Wight" outbreak—have helped to centre the interest of bee-keepers on the scientific aspects of their subject.

Research and Bee-keeping.—Government interest in scientific research as applied to bee-keeping may, for practical purposes, be said to date from the time when bee-keepers made their appeal for help in the fight against the so-called "Isle of Wight" disease. The work of the Cambridge investigators, which demonstrated the existence of Nosema disease in

England, was carried out under the Board of Agriculture. Subsequently, Dr. Rennie and his collaborators made the discovery of the parasitic mite now recognised as the cause of the greater part of our losses of adult bees. This work was made possible owing to the interest taken by Mr. A. H. E. Wood of Glassel, and was carried out under the auspices of the Scottish Board of Agriculture.

Of Bee-keeping Research Stations abroad, there are, in the United States, the Bee Culture Laboratory near Washington under the Department of Agriculture of the Federal Government, and numerous problems are being investigated at the Agricultural Experiment Stations of the various states. Germany has the Bee Garden and Laboratory at Erlangen under Dr. Zander, and France has now a Bee Institute at Cagnes in the charge of M. Vincens.

Bee Research at Rothamsted.—Under a grant from the Development Fund a Bee Research Institute was started at Cambridge in 1919. The Institute was moved to Rothamsted in 1922, and is attached to the Entomological Department of the Institute of Plant Pathology. The writer was appointed to take charge in the spring of 1923.

At Aberdeen, diseases of the bee are the subject of study; at Rothamsted research is directed towards bees in a state of health, and problems of practical bee-keeping. Up to the present, attention has been mainly directed to two problems: namely, the use of metal combs, and the question of the direction of the combs in relation to the entrance of the hive.

Metal Combs.—As regards the first of these problems: the reason may not at first be apparent why naturally-built wax combs are not sufficient for the needs of the modern bee-keeper. The movable comb quickly led to the invention of comb-foundation which serves for a mid-rib to guide the bees in building their combs. The liability of plain wax foundation to stretch and even to break down while being built out, and the strain put on combs when the ordinary centrifugal honey extractor is used at high speeds, quickly led to a desire to reinforce the wax.

Metal semi-combs are an elaborate attempt to achieve this, and it was further thought that the immutability of the cells would cause bees to make perfect worker combs, and so restrict the rearing of drones, while it was claimed that the saving in wax secretion necessary to complete the comb would compensate for the higher initial price of the artificial product,

FIG 1 —Part of the Home Apiary

FIG 2 —Apiary Hut and Laboratory

and further, that the wax moth would be unable to damage these combs.

The experience with metal semi-combs at Rothamsted has not been satisfactory. The bees only complete these combs at all when there is a good honey-flow, and then only the strongest colonies seem able to do so. The egg-laying of the queen becomes restricted and patchy, as though she were failing through age. If a single comb of wax be left in the brood-chamber, brood-raising will be almost wholly confined to it in preference to the metal semi-combs. Far from economising food owing to the saving in wax secretion, stores rapidly used as fuel to keep up the temperature of the hive. It has been said that a strong colony completely filling a brood-chamber will completely envelop the combs and there will be no loss of heat by conduction of the metal. One can imagine this being so where the combs of the brood-chamber are entirely filled with brood, which in actual fact is rarely the case, and which I have never known to be even approximately so where metal combs are used. What actually occurs, however, is that the metal semi-combs conduct heat from the cluster much as do the radiating fins on the cylinder of an air-cooled internal combustion engine.

It may be said then that, as far as our experience goes at present, metal semi-combs are unsuitable for use in this climate. Their use tends to an undue consumption of food in order to maintain the hive temperature both in summer and winter. At the same time brood-rearing is diminished partly, no doubt, owing to the difficulty of keeping up the temperature of the brood nest, and in consequence the population decreases. The result is weakened colonies, consisting of aged bees, which seem to be more liable to be attacked by "Isle of Wight" disease, and less surplus honey than one would get from a normal colony working on wax combs.

A point noticed in this connection was the case of a faulty batch of metal semi-combs in which the cells were slightly too small. The bees, being unable to tear down the metal walls, attempted to revise the pattern by leaving out a portion of a row here and there and overlapping from above and below. Where a wax cell was thus badly out of register with the metal below a false bottom of wax was built and the cell lengthened to the requisite amount above the general level. (This lengthening is also frequently to be seen over the row of cells which contains the horizontal strengthening

wire.) The result was a very uneven comb somewhat similar in appearance to the combs of a drone breeding colony. This matter of size of cell opens up the question whether the embossed bases of commercial wax-foundation are equally suitable for all races of bees.

Used in the supers, the metal semi-combs are much less readily occupied than are fully-built wax combs, less even than frames of comb foundation. In the extractor they are of course practically indestructible, and it is possible that in warm climates with heavy flows of nectar there might be advantage in their use, particularly in localities where very thick honeys similar to that of our heather, such as the "manuka" honey of New Zealand, have to be dealt with.

Position of Combs.—The second problem is that of the position of combs relative to the entrance to the hive. Naturally-built combs in skeps and in bee trees give us no reliable data to go on. A proportion of such colonies have combs hanging curtainwise across the entrance; other colonies have them at right angles so that the spaces between the combs communicate directly with the outside; and, again in other cases the combs run in a diagonal manner, or are irregular in shape and direction. These conditions seem to depend rather on the shape of the spaces available to the bees for comb building, and more particularly on the nature of the support from which the combs hang.

It has been stated that the curtain-like arrangement, where the combs run parallel with the front of the hive, affords greater protection from draughts and is consequently warmer in winter while at the same time it is said to be liable to become too hot in summer. This has earned for it in Germany the name of "Warmbau-stellung" and has been referred to by English writers as "Warm-Way." In Germany it is looked upon as the natural arrangement for the tall combs which are sometimes used in that country. On the other hand, in England it is used not only with the British Standard Frame which has a length greater than its height, but chiefly by users of the "Long Idea" type of hive, having a brood chamber of many combs hanging transversely, so that it is comparatively deep from back to front. The converse arrangement, where the combs are at right angles to the front of the hive, is said to allow freer ventilation, and on that account to be colder in winter and cooler in summer, while at the same time causing less hindrance to ingress and egress from the hive during the active season. This is probably the more common arrangement in this country, while

it is almost universally used in the great honey-producing countries of the world—North America, New Zealand, and Australia—since the Langstroth hive is of this type. Up to the present nothing very definite can be said as to the results in this direction.

Methods.—In the course of this work it has been necessary to take a large number of temperature readings within the cluster of bees, both in summer and winter, and that with the minimum of disturbance. For this purpose the Electric Thermocouple has been used in place of ordinary mercurial thermometers. Thermocouples of copper and "constantan" wire, soldered together, were embedded in the comb-foundation and led separately along the top bar of the frame to terminals in the outer wall of the hive. At any time it is possible to read the temperature by connecting a galvanometer to these terminals, and without any disturbance of the bees.

The experimental hives are weighed at intervals and a hive is kept permanently on scales under cover. This hive is weighed three times daily to the nearest quarter of an ounce, and affords an indication of the state of the nectar flow, and of the effect of weather.

Further Experiments.—Further experiments are being planned to deal with the question of syrup feeding for winter stores. Also, in connection with the question of temperature and the position of combs, a study of ventilation will be made, which it is hoped may throw some light on the problem of moisture within the hive. Single-walled, double-walled and packed hives are being used in the experiments, and it is hoped that facts will come to light as to the value of packing and of the advantage, if any, of the double-walled type, in our climate, over single-walled hives. For the present, work has been confined to the British Standard Frame, because it is generally used in this country. In order not to complicate results, a single race of bee has been used—the Italian—as this appears to be more suitable for experimental purposes than others. It will be necessary to bear this in mind in interpreting results.

In conclusion it is necessary to remind bee-keepers that in spite of precautions there is a great tendency for individual colonies of bees to vary: so much so that differences in performance due to experimental conditions may easily be

masked. It will therefore be necessary to continue observations over a number of years under varying conditions as to weather and nectar-flow, and with larger numbers of colonies, before it will be possible to come to any definite conclusions. Finally, bee-keepers must make due allowance for climate and race of bee when applying such results to their own conditions.

THE CONTROL OF APPLE SCAB

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HE following article gives an account of spraying experiments against apple scab which were carried out during 1925 in a commercial plantation at Egerton, Kent.* The trees sprayed were bush trees of the variety Bismarck planted in 1915, on stiffish loam, at 14 ft. square, and were the same as those used in the spraying experiments in 1923 and 1924, the results of which have already been published in this JOURNAL.† The three rows of Bismarcks (containing ninety-five trees) used in the experiments were separated from each other by rows of the variety Lane's Prince Albert, which gave protection from accidental spray drift. The scheme of experiments in 1925 differed in some respects from that of 1923 and 1924, the plots being arranged so that groups of trees received respectively either two or three applications of Bordeaux mixture or of lime-sulphur, while one group was sprayed with lime-sulphur plus lead arsenate, applied three times. An improvement on the scheme adopted in 1923 and 1924 was also made in having a larger number (twenty-five) of unsprayed (control) trees, which were so distributed that some were present in all the three rows of trees that were sprayed (see Table II).

The spraying was carried out with a 4-ft. brass rod fitted with the Drake and Fletcher " Mistifier " nozzle provided with the smallest disc, viz., number 0. The spraying machine (Weeks and Son) was provided with a lead consisting of one

* This opportunity is taken of thanking Captain R. D. Scoble-Hodgins for allowing the experiments to be carried out on his trees, and for kindly providing the necessary apparatus.

† *Jour. Min. of Agric.*, XXXII, May, (1925), pp. 137-149.

60-ft. length of rubber hose-piping and the power was supplied by a small 2 h.p. Emerson-Brantingham petrol engine. The spray was applied at a pressure of from 100 to 120 lb.; at the different applications from ¾ to 1½ gallons of the spray-fluid were used on each tree. All the spraying was carried out by one person,* so as to ensure uniformity of treatment for each tree.

The spray-fluids used were Bordeaux mixture, lime-sulphur, and lime-sulphur plus arsenate of lead. The chemical composition of the brand of lime-sulphur used, viz., "Sulfinette," was found to be as follows: Sp. gr. 1·30, polysulphide sulphur 19·34 per cent. Swift's arsenate of lead paste was used; the analysis of a number of samples showed that the material contained 15·87 per cent. of total arsenic oxide (As_2O_5), of which 0·158 per cent. was water-soluble. As regards the lime-sulphur plus arsenate of lead wash, the manner of mixing the two constituents was as follows:—1 gallon of the concentrated lime-sulphur was mixed with 28 gallons of water, the further gallon of water—*i.e.*, 1 : 29—being used to make the lead arsenate paste (1 lb. 3 oz., equivalent to 4 lb. lead arsenate paste to 100 gal. wash) into a thin cream. The diluted lime-sulphur and lead arsenate were then mixed together and at once transferred to the spray tank. The Bordeaux mixture was made on the formula: 8 lb. copper sulphate, 8lb. quicklime, 100 gal. water. The lime-sulphur solution consisted of one gallon of the concentrate added to 29 gallons of water.

The first application was made on May 4, when the blossom-buds were well forward and showing pink. No rain fell during or immediately after the operation; the sky was overcast, and a fresh wind blowing. The second application took place on June 4. At this date† the petals had all fallen and the fruit was already ⅜ in. in diameter. The weather conditions were cloudless sky, hot sunshine and very little wind. The third spraying was carried out on June 23; the weather was cool and cloudy, with no sunshine, and an occasional breeze.

Biological Observations.—(a) *Incidence of "Scab."*—On April 7, all the trees used in the experiment had been examined and had been found to be practically free from scab-pustules on the young wood.‡ On June 4, an inspection was made

* N. B. Bagenal.

† A better date for the second spraying would have been fully a week earlier; other engagements in the county, however, made June 4 the earliest date available.

‡ For further details on this point see: *Salmon, E. S. and Ware, W.M.*, in *Journal of Pomology*, IV, June (1925).

of all the trees previous to the application of the sprays given that day. Twenty-one of the twenty-five unsprayed (control) trees showed a long-established attack of scab on the older leaves, which were, very generally, in the "sooty" condition. The newer foliage was affected only slightly, but a few of the larger leaves were either plentifully spotted or were becoming "sooty." Owing to the fact that the newer foliage was more abundant, also more conspicuous and on the whole fairly clean. these control trees might well have been described by any grower as in healthy condition, the older infected leaves being often hidden by fresh growth. It was evident, however, on closer examination that a severe attack of scab was developing. Of the remaining control trees, all in Row 3, two were only very slightly attacked and on the other two no scab was found.

Of the fourteen trees about to be sprayed with Bordeaux mixture twice, ten were free from scab and the remainder showed only a few older and a few younger leaves to be spotted. No scab was found on the trees destined to receive three applications of Bordeaux mixture, except on two where a few spots occurred.

Of the fourteen trees about to receive lime-sulphur twice, twelve showed their older leaves commonly "sooty" or even starting to shrivel up under the attacks of scab, while many of the younger leaves were also becoming spotted or lined with scab along the veins. The first scab attack on the young fruit was noticed on one of these trees. On the remaining two trees, scab attack was found on the older blossom-truss foliage, but to a less extent; and the younger leaves were quite healthy. There was a remarkable diminution in the amount of scab present on the trees receiving three applications of lime-sulphur. The fungus was rare, but here and there an older leaf was found in a "sooty" condition. In two cases it was noticed that some older leaves, which had evidently been missed by the spray, were heavily attacked. Three instances of the fungus apparently continuing to develop on the surface of lime-sulphur deposit were noticed.

A similar absence of scab was recorded from the trees receiving three applications of lime-sulphur and arsenate of lead. Either the tree was quite healthy, or only two or three spots were to be found on the foliage. Leaves in the "sooty" condition were noticed on one or two leaders which had been missed by the spray.

From the above observations it would appear that the first spraying (on 42 trees), whether with lime-sulphur or Bordeaux

mixture, had effectively protected the foliage, and this was borne out by the contrast afforded by the unhealthy condition of the trees about to receive lime-sulphur twice but as yet unsprayed, and of the control trees (total 33). On the other hand, the fourteen trees about to receive two applications of Bordeaux mixture were almost entirely healthy, although not yet sprayed.

A second inspection of the plantation was made on June 23, immediately before the third spraying was carried out. The previous fortnight had been hot and sunny, and there were six to eight inches of new growth on the leaders and laterals (" breast wood "). The fruit had now grown to $1\frac{1}{8}$ in. in diameter, and it was noticed that a slight drop was taking place, probably a natural thinning of the smaller fruit, the diameter of which was about $\frac{1}{2}$ in. The stalks of such fruits were yellowish in colour.

Taking the trees in the same order as before, those unsprayed (controls) showed a very general attack of scab ; the greater part of the foliage was spotted, and on different trees the number of " sooty " leaves, at a rough estimate, varied from about one-twentieth to one-third of the total foliage. Most of the fruit was already scabbed. Cracks up to half-an-inch long, as a result of scab, were noticed on several apples. As evidence of the progress of the disease, it was noted that the sixth or seventh leaf from the youngest one on the new growth was attacked. Eight of the twenty-five control trees, however, were only slightly attacked and their fruit was moderately clean. These were all in Row 3. The second group (Bordeaux mixture twice) was clean or only slightly affected. The leaves were well covered with Bordeaux mixture and there was no scorch. It was noticed that several fruits were spotted with scab and that the leaves high up on the leaders were here and there affected. On the whole, the youngest foliage was still clean. The next group (Bordeaux mixture three times) was even more healthy than the last ; there was very little scab to be seen. Occasionally a few leaves, near the tips of branches were spotted or even " sooty," but the greater part of the foliage was clean. The fruit, however, was occasionally scabbed. A natural thinning of small apples was noticed in this group.

Twelve of the trees receiving two applications of lime-sulphur were noticeably scorched. In bad cases, one-half or more of the leaf was of a red-brown colour and a slight leaf-fall was noticed. On all the fourteen trees the foliage was fairly healthy, but some leaves where the spray had missed were either " sooty " or were spotted with pale areas of scab. The fruit was

generally clean, but occasionally scabbed, and was then starting to crack. A drop of small apples from the crowded trusses was taking place. The younger foliage was not yet badly scabbed, but a few spots were starting on the lowest leaves of the new growth.

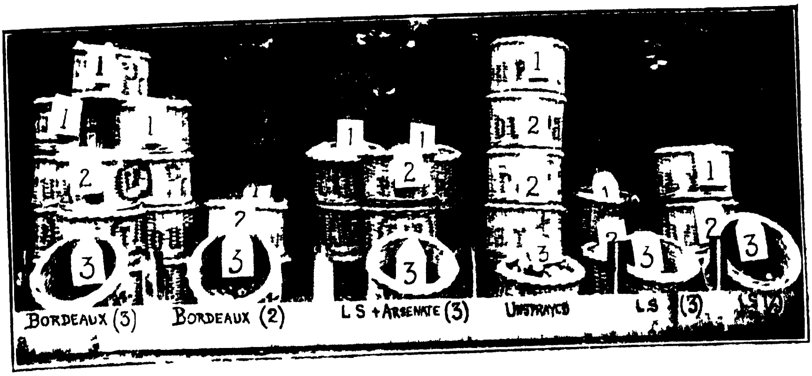
In the next group, receiving three applications of lime-sulphur, nine of the fourteen trees were slightly scorched and there was a little leaf-fall, whereas on the remaining five trees there was no scorch or, at most, a reddish-brown spotting. Both here and in the last group the most prominent feature was that the leaves were marked with light yellow-green spots of scab, showing through the lime-sulphur or appearing where there was no spray deposit. The new growth and the fruit was clean or had only a few spots.

No serious scorching injury was evident on the trees of the last group (lime-sulphur plus lead arsenate), and what little occurred was limited to the margins of about three-quarters of the foliage on one tree, to the margins of injuries caused by the "case-bearer" insect on another, and to about a dozen leaves on each of two other trees. Scab was general in the "pale spot" state described above, and leaves were only rarely seen in the "sooty" condition. The new growth was healthy and the fruit only slightly attacked.

(b) *Fruit Drop.*—On July 20, the plots were examined to ascertain whether any dropping of the fruit had occurred as a result of spraying. All apples measuring from $\frac{3}{8}$ in. to about $1\frac{1}{2}$ in. in diameter, found on the ground under each tree, were counted (Table I), together with the number of apples gathered from the trees at the final picking. The fallen fruit did not show evidence that any general attack by insects (such as sawfly or codling moth) had caused an appreciable drop.

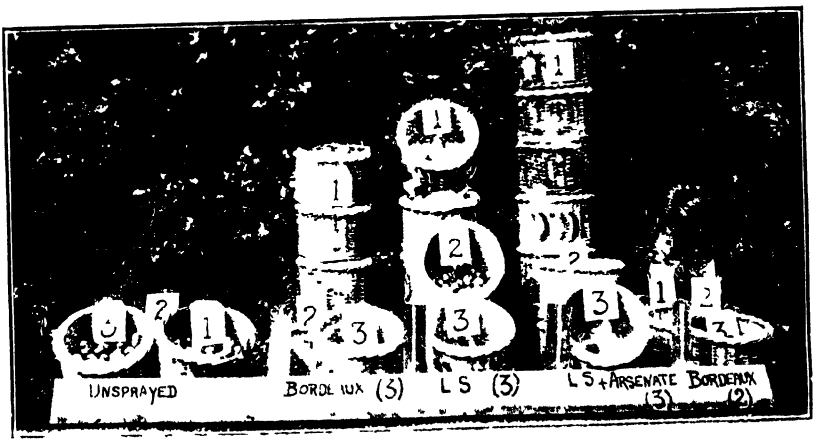
In *Row* 1 the greatest percentage drop was from the five trees sprayed with lime-sulphur plus arsenate of lead (29·8 per cent.), though from the unsprayed (control) trees the drop was not much less (26·5 per cent.). Trees having two and three applications of Bordeaux mixture respectively showed a percentage drop below that of the unsprayed trees, hence it would appear that no damage had been caused by this spray. Similarly, but in contradiction of the results obtained in 1924* no damage could be attributed to lime-sulphur whether applied twice or thrice, since, from the trees so treated, the drop was as low as 12·2 per cent. and 8·0 per cent. respectively.

* *Jour. Min. of Agric.*, XXXII, p. 146 (1925).

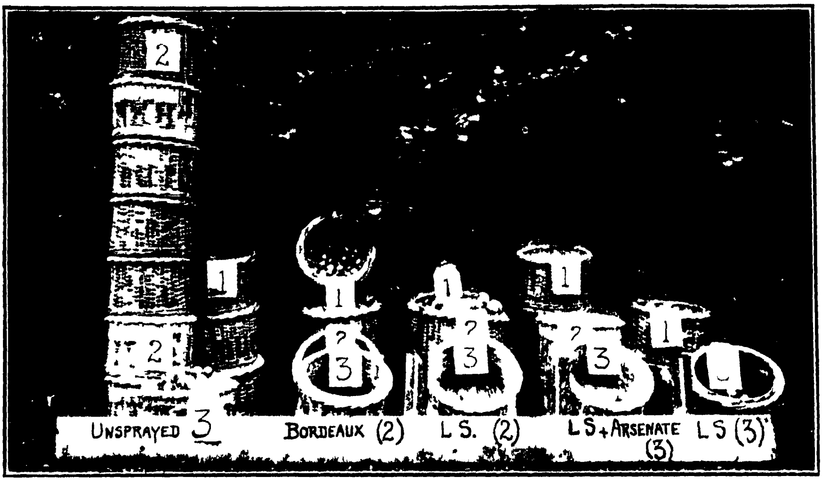


Row I

	Grade I		Grade II		Grade III		No.
	lb	Baskets	lb	Baskets	lb	Baskets	Trees
Bordeaux (3)	332	[illegible]	10[illegible]		[illegible]	1	[illegible]
Bordeaux (2)	[illegible]	[illegible]	[illegible]	2	4	1	4
Lime Sulphur and Arsenate of Lead (3)	[illegible]	6	[illegible]	3	3	1	5
Unsprayed	4	1	110	4	5[illegible]	1	10
Lime Sulphur (3)	67	2	[illegible]	1	[illegible]	1	[illegible]
Lime Sulphur (2)	4[illegible]	1	68	2	10	1	[illegible]



	Grade I		Grade II		Grade III		No.
	lb	Baskets	lb	Baskets	lb	Baskets	Trees
Unsprayed	1[illegible]	1	57	1	20	1	4
Bordeaux (3)	15[illegible]	4	31	1	2	1	6
Lime Sulphur (3)	14	4	48	2	4	1	5
Lime Sulphur and Arsenate of Lead (3)	211	6	69	2	4	1	6
Bordeaux (2)	24	1	14	1	3	1	5



Row 3

	Grade I		Grade II		Grade III		No
	lb	Baskets	lb	Baskets	lb	Baskets	Trees
Unsprayed	102	3	239	7	40	1	11
Bordeaux (2)	87	3	28	1	2	1	[illegible]
Lime Sulphur (2)	77	2	66	2	7	1	8
Lime Sulphur and Arsenate of Lead (3)	97	3	51	2	4	1	3
Lime Sulphur (3)	47	2	13	1	2	1	3

FIG 1 — Rows 1, 2 and 3 The entire crop of apples from the sprayed trees in each row, showing result of grading the fruit

No deduction can be made from this illustration as to any effect of the different sprays on yield, but their relative efficiency in controlling scab may be judged by comparing the ratio of fruit in Grades 1, 2 and 3 under the different treatments

STONEBRIDGE GREEN FARM, EGERTON ; SPRAYING EXPERIMENTS, 1925

TABLE I.—Showing the percentage of "dropped" apples, Bismarck variety, July 20, 1925.

		Bordeaux Mixture twice	Bordeaux Mixture thrice	Control, no spray	Lime-sulphur twice	Lime-sulphur thrice	Lime-sulphur Lead-arsenate thrice
Row 1	Number of trees	4	8	10	6	6	5
	Number of dropped apples	169	540	366	51	31	645
	Number of apples picked	752	1,835	1,017	368	404	1,520
	Total apples	921	2,375	1,383	419	439	2,165
	Percentage dropped	18·4	22·5	26·4	12·2	8·0	29·8
Row 2	Number of trees	5	6	4	—	5	6
	Number of dropped apples	42	154	251	—	93	271
	Number of apples picked	198	908	376	—	998	1,240
	Total apples	240	1,062	627	—	1,091	1,511
	Percentage dropped	17 5	14·5	40 0	—	8 5	17·9
Row 3	Number of trees	5	—	11	8	3	3
	Number of dropped apples	177	—	548	34	45	100
	Number of apples picked	728	—	1,844	563	331	694
	Total apples	905	—	2,392	597	376	794
	Percentage dropped	19·6	—	22 9	5 7	12·0	12 6
Total apples		2,066	3,437	4,402	1,016	1,906	4,470
Percentage drop (of total)		18·8	20 2	26 5	8 4	9·1	22·7

In *Row* 2 where there were only four unsprayed trees, these showed the greatest drop (40 per cent.). This very high figure was due to the drop being over 50 per cent. with each of two of the trees. None of the sprays used was associated with more than 17·9 per cent. drop. Here again, the proportion from the five trees sprayed with lime-sulphur was very low (8·5 per cent.).

With regard to *Row* 3, the unsprayed trees again showed the greatest drop (22·9 per cent.) and, of the others, those sprayed with lime-sulphur twice and thrice showed only 5·7 per cent. and 12·0 per cent.

It seems reasonable to suppose that the intensity of scab attack is likely to vary little throughout any one row of a susceptible variety, such as Bismarck, flanked by rows of the more resistant Lanes' Prince Albert, and therefore a comparison such as that given above, of the drop found in different sections of each row is likely to provide the best basis on which to judge the effects of the sprays used.

If, however, all the fourteen trees which had the same spray treatment (in whatever rows they were situated) are compared as regards drop with any other set of fourteen, or with the twenty-five control trees, a greater crop of apples is available from which to calculate the percentage figures. These percentages are given at the foot of Table I, and they confirm the results already obtained (when the comparison is made within the row).

Thus, from the unsprayed trees, with a total of 4,402 apples there was a drop of 26·5 per cent., and from those sprayed with lime-sulphur plus arsenate of lead (4,470 apples) a drop of 22·7 per cent. With Bordeaux mixture, twice and thrice, the drop was 18·8 per cent. and 20·2 per cent. respectively; and with lime-sulphur, twice and thrice, it was as low as 8·4 per cent. and 9·1 per cent. respectively.

Some evidence obtained in 1924 indicated that the lime-sulphur wash, both alone and with lead arsenate, caused a dropping of the young fruit. It is clear from the results recorded above that no such evidence can be gathered from the data collected in 1925; and it appears safe to conclude that in this season none of the sprays used caused an abnormal dropping of the fruit. It is at present impossible to explain the reason for the percentage of "drops" being the lowest in the case of trees sprayed with lime-sulphur. The very different observations in two consecutive seasons indicate that dropping of the fruit is a complicated phenomenon needing a thorough investigation by the pomologist.

The Crop Graded for Scab.—The 95 trees used in the experiments produced a crop of approximately 70 bushels, the total weight being 1 ton 7 cwt. 43 lb. The crop was picked from each plot separately, and the apples were graded by hand,* according to the amount of "scab" present, into three classes; Grade 1 consisting of apples entirely free from scab;† Grade II of those apples in which the scab spots were few or many, but which were not unmarketable; and Grade III, of those apples which were so cracked or disfigured by scab as to be unmarketable. The number and the weight of fruits from each tree and plot were ascertained, and the results are shown in Table II.

It will be best to consider them under three headings:—(1) the fungicidal effect of the three spray-fluids used; (2) the effect of three applications of each fungicide as compared with two applications; and (3) any injurious effects resulting from the spray-fluids used.

(1) Bordeaux mixture applied three times gave the most complete control of scab. In Row 1, where the unsprayed trees gave only 13·9 per cent. by number‡ of scab-free apples, with 24·5 per cent. of unmarketable fruit, the sprayed trees gave 74 per cent. both by number and weight of scab-free apples and only 0·7 per cent. of unmarketable fruit. In Row 2 the unsprayed trees gave 18·1 per cent. by number of scab-free apples and 27·1 per cent. of unmarketable fruit, while the sprayed trees bore 80·1 per cent. of scab-free apples, with only 1·4 per cent. of unmarketable fruit.

The next most efficacious spray-fluid was lime-sulphur plus arsenate of lead, applied three times. In Row 1 the sprayed trees gave 69·3 per cent. by number of scab-free apples, with 1·2 per cent. of unmarketable fruit. In Row 2 the sprayed trees gave 72·9 per cent. scab-free apples, with 1·9 per cent. of unmarketable fruit.

Lime-sulphur alone, applied three times, was not so efficacious; in Row 1 only 55·2 per cent. of the apples were free from scab; in Row 2 the percentage was 68·9.

* All the grading was carried out by the same two persons.

† Whilst from the commercial standpoint these apples were free from scab, as many as three very minute spots on an apple (each not larger than the head of a pin), were not considered sufficient to reduce that fruit to the level of Grade II. Such cases were numerically very small.

‡ The percentages obtained by weight approximate very closely to those obtained by number.

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TABLE II.—Grading of Apples (Bismarck variety).

Spray-fluid	Row	No of trees	No. of apples picked	No. of apples in grade* 1	No. of apples in grade* 2	No. of apples in grade* 3	Percentage No of. apples in grade* 1	Percentage No of. apples in grade* 2	Percentage No of. apples in grade* 3	Wt. of apples lbs.	Weight of apples in grade* 1	Weight of apples in grade* 2	Weight of apples in grade* 3	Percentage weight of apples in grade* 1	Percentage weight of apples in grade* 2	Percentage weight of apples in grade* 3
Bordeaux Mixture applied twice (8:8:100)	1	4	752	385	349	18	51·2	46·4	2·4	151	82	65	4	54·3	43·0	2·7
	2	5	198	105	76	17	53·0	38·4	8·6	41	24	14	3	58·5	34·2	7·3
	3	5	728	528	188	12	72·5	25·8	1·7	117	87	28	2	74·4	23·9	1·7
		14	1,678	1,018	613	47	60·7	36·5	2·8	309	193	107	9	62·5	34·6	2·9
Bordeaux Mixture applied thrice (8:8:100)	1	8	1,835	1,368	454	13	74·6	24·7	0·7	444	332	109	3	74·8	24·5	0·7
	2	6	908	727	168	13	80·1	18·5	1·4	189	156	31	2	82·5	16·4	1·1
		14	2,743	2,095	622	26	76·4	22·7	0·9	633	488	140	5	77·1	22·1	0·8
Lime-sulphur plus lead-arsenate applied thrice (Lime-sulphur 1:29 plus arsenate of lead paste, 4 lb. to 100 gal. wash)	1	5	1,520	1,053	448	19	69·3	29·5	1·2	317	225	89	3	71·0	28·1	0·9
	2	6	1,240	904	312	24	72·9	25·2	1·9	284	211	69	4	74·3	24·3	1·4
	3	3	694	415	259	20	59·8	37·3	2·9	155	97	54	4	62·6	34·8	2·6
		14	3,454	2,372	1,019	63	68·7	29·5	1·8	756	533	212	11	70·5	28·0	1·5
Lime-sulphur applied twice (1:29)	1	6	368	109	221	38	29·6	60·1	10·3	120	42	68	10	35·0	56·7	8·3
	3	8	563	261	268	34	46·4	47·6	6·0	150	77	66	7	51·3	44·0	4·7
		14	931	370	489	72	39·8	52·5	7·7	270	119	134	17	44·1	49·6	6·3
Lime-sulphur applied thrice (1:29)	1	6	404	223	151	30	55·2	37·4	7·4	112	67	39	6	59·8	34·8	5·4
	2	5	998	688	284	26	68·9	28·5	2·6	195	143	48	4	73·3	24·6	2·1
	3	3	331	169	154	8	51·1	46·5	2·4	92	47	43	2	51·1	46·7	2·2
		14	1,733	1,080	589	64	62·3	34·0	3·7	399	257	130	12	64·4	32·6	3·0
Control (No spray)	1	10	1,017	141	627	249	13·9	61·6	24·5	227	34	140	53	15·0	61·7	23·3
	2	4	376	68	206	102	18·1	54·8	27·1	92	15	57	20	16·3	62·0	21·7
	3	11	1,844	496	1,104	244	26·9	59·9	13·2	381	102	239	40	26·8	62·7	10·5
		25	3,237	705	1,937	595	21·8	59·8	18·4	700	151	436	113	21·6	62·3	16·1

* Grade 1 : Entirely free from scab ; Grade 2 : Scab spots few or many but apple not too seriously affected to be unmarketable ;
Grade 3 : Apple so cracked or disfigured by scab as to be unmarketable.

Interesting results showing the efficacy of Bordeaux mixture were obtained also from Row 3. Here the percentages of scab-free apples were :—from the unsprayed trees, 26·9 ; from the trees sprayed twice with Bordeaux mixture, 72·5 ; sprayed three times with lime-sulphur and lead arsenate, 59·8 ; sprayed three times with lime-sulphur, 51·1, and sprayed twice with lime-sulphur, 46·4.

Taking the unsprayed trees, row by row, and comparing the amount of disease present on the crop with that on the crop from sprayed trees *in the same row*, we obtain figures which show in the plainest way possible the good results derived fron spraying. In Rows 1 and 2 a quarter of the crop as compared with one-tenth (to take the most unsuccessful spraying result) was in an unmarketable condition, owing to the amount of scab ; in Row 3 there was less disease, 13·2 per cent. by number being in an unmarketable condition. In this row, however, only 26·9 per cent. of the apples were free from scab, whereas the percentage of healthy apples in the crop from the trees in the same row, sprayed twice with Bordeaux mixture, was 72·5.

(2) The advantage of spraying three times instead of twice is shown very clearly both in the Bordeaux mixture and in the lime-sulphur plots. In Row 1, the trees sprayed twice with Bordeaux mixture gave only 51·2 per cent. of scab-free apples, while 2·4 per cent. were unmarketable ; in the same row, the crop, from the trees sprayed three times with Bordeaux mixture, gave 74·6 per cent. of scab-free apples and only 0·7 per cent. of unmarketable apples. Similarly, in Row 2, the twice-sprayed trees gave 53 per cent. of healthy apples and 8·6 per cent. of unmarketable fruit, whilst the trees sprayed thrice gave 80·1 per cent. of healthy apples and 1·4 per cent. of unmarketable fruit. In the case of Bordeaux mixture, then, the additional early spraying given in May resulted in an increase of scab-free apples of 23 per cent. in Row 1, and of 27 per cent. in Row 2.

With lime-sulphur, the trees sprayed twice gave, in Row 1, 29·6 per cent. of scab-free apples with 10·3 per cent. of unmarketable apples ; whilst the crop from the trees sprayed three times gave 55·2 per cent. of scab-free apples, with 7·4 per cent. of unmarketable apples.

In Row 3 (where, as the unsprayed trees showed, there was less disease present) the trees sprayed twice gave 46·4 per cent. of healthy apples, with 6·0 per cent. of unmarketable apples ; the trees in the same row, sprayed three times, gave 51·1 per

cent. of healthy apples, with 2.4 per cent of unmarketable apples. In the case of lime-sulphur, then, the additional early spraying resulted, in Row 1, in an increase of scab-free apples of 25 per cent.; in Row 3, with less disease present, the improvement was scarcely noticeable.

(3) With regard to the injurious effect (if any) of the sprays, this has already been discussed in relation to fruit-drop. The scorch and leaf-fall due to the first application of lime-sulphur, to those trees to be sprayed twice only, was noticed on June 23, and although, at the time, it appeared to be serious in a few cases, no material damage can be attributed to it, at least in the 1925 season. The slight scorching effect noticed on the trees about to receive the third application of lime-sulphur had no serious results in the 1925 season.

As recorded above, no injurious effects from the first or second applications of Bordeaux mixture were visible on June 4 or 23. When the "drops" were counted on July 20, the percentages obtained from trees sprayed twice and thrice with Bordeaux mixture, compared with those from the unsprayed, did not indicate that any fall of the fruit had been caused by this spray. At that date also, *i.e.*, one month after the final spraying, no harmful effect on the foliage was apparent. It was not until ten weeks later (September 30), that it was observed that premature leaf-fall was taking place. While the leaves of unsprayed trees were yellowing and there was a slight fall, more especially from the tips of the "leaders," all trees sprayed twice or three times with Bordeaux mixture were almost completely defoliated, their appearance presenting a great contrast to that of adjoining trees.

Leaf-fall such as this might be expected to influence adversely the growth of the fruit. In the case of the crop picked from trees twice sprayed, it was found that the average weight of the individual apple was lower than any other, including the controls. Where, however, the trees had been sprayed three times the average weight of the apple was greater than that obtained under any other treatment except lime-sulphur twice applied, and in this case the small crop may be held responsible for larger fruits, so that in the light of these results it cannot be concluded that comparatively late defoliation had any effect on the crop in that season.

No premature leaf-fall, such as this, was occasioned in 1924, when the same trees were similarly sprayed; and the results in 1925 would appear to indicate that spray injury is not alone

dependent on the variety of tree and the composition of the spray used, but also upon such factors as weather conditions following the application, or, perhaps, seasonal vigour of the tree itself.

Summary.—(1) The variety Bismarck (like several other commercial varieties) becomes infected by the scab fungus first on the leaves produced *before blossoming time*, and successively on the later foliage. To control the disease, therefore, three applications of a fungicide are necessary and of these the early spraying, given at the pre-blossoming ("pink bud") stage of growth, is essential.

(2) In spraying experiments in 1925, where the unsprayed trees produced only 15 per cent.* of healthy apples, and 25 per cent. of fruit so badly diseased as to be unmarketable, the crop from the trees in the same rows, sprayed three times, was as follows :—Bordeaux mixture :—scab-free apples, 76 per cent., unmarketable, 1 per cent. ; lime-sulphur plus lead arsenate :—scab-free, 71 per cent., unmarketable, 2 per cent. ; lime-sulphur :—scab-free, 65 per cent., unmarketable, 4 per cent.

(3) The beneficial effects of the additional early spraying at the "pink-bud" stage was shown in the increase of the percentage of apples free from the disease, over that obtained where only two later applications were made. This increase was as follows : Bordeaux mixture, 25 per cent. ; lime-sulphur 14 per cent.†

(4) Serious leaf-fall was occasioned late in the season by the use of Bordeaux mixture (both when applied twice and three times). No harmful effect, however, on the season's crop from these trees was observable.

(5) No evidence was obtained that in 1925 any of the spray-fluids used causing a dropping of the young fruit.

* These figures refer to the crops in Rows 1 and 2.

† These figures refer to the crops in Rows 1 and 2, in the case of Bordeaux mixture, and in Rows 1 and 3, in the case of lime-sulphur.

THE CONTROL OF THE APPLE CAPSID BUG

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Previous experiments have shown that washes containing nicotine are the most effective in killing this pest, and that soft soap and nicotine, if properly applied, afford an economic means of controlling it. Complaints have been received from growers, however, that they were unable to control capsid bug by spraying with soft soap and nicotine.

Causes of Spraying Failures.—Many of these cases were investigated and the cause of the failure found to be due to one or more of the reasons dealt with below.

(1) Spraying at the Wrong Time.—The capsid bugs often hatch over a long period, especially when a spell of cold weather sets in shortly after the commencement of hatching. The following table give the dates of hatching as compared with the dates of blossoming in the Wisbech district :—

Year	First markings of Capsid seen	Capsids finished hatching	Apples in full bloom
1917	May 7	May 13	May 23
1918	April 8	May 8	May 16
1919	May 2	May 9	May 19
1920	March 27	—	April 20
1921	March 25	-	April 18
1922	April 25	—	May 22
1923	April 7		—
1924	April 23	—	—
1925	April 14	About May 9	May 18

From this it will be seen that while all the capsids *may* hatch in a week, a month may elapse before the last ones hatch. In 1918 and 1925 a cold period in April and May lengthened the period of hatching. Many growers spray soon after the markings of the bug are noticed, which in some years is long before all the bugs have hatched, and later on are disappointed at finding capsids still busy on the trees. The above table shows that *all the capsids have usually hatched about a week or ten days before the trees are in full bloom, and this is the best time to begin spraying.* Any trees sprayed before then should be sprayed again.

The marking of the fruit begins a few days after the fruit has set, but spraying after this date will reduce the bugs for another year.

(2) **Incorrect Methods of Spraying.**—Many growers do not spray their trees thoroughly, and we have demonstrated this to growers by spraying some of their trees according to the following method: A pump giving a pressure of over 70 lb. per square inch should be employed. *A coarse nozzle must be used* which should point at an angle to the lance so that the spray can be directed downwards on the shoots. The nozzle is then moved up and down each shoot at a distance of 6-12 inches from the shoots. By this method more of the spray fluid goes into the expanding trusses where the young capsids are.

Satisfactory control of the capsid bug has been obtained with the same wash as that used by the grower in the same orchard with uneconomic results.

(3) **Unsuitable Water.**—Unfortunately in the Wisbech area, where this pest is particularly troublesome, many of the growers are unable to use soft soap and nicotine for spraying purposes, on account of the hardness of the dyke water, which is often the only source of supply.

During the winter of 1924-25, several waters from the Wisbech area were examined. In order to determine the hardness, the amount of commercial fish oil soft soap (as used in spraying) required to produce a permanent lather was ascertained, as shown in the following table :—

Source of water	Quantity of fish oil soft soap required to soften 100 gallons of water
W. Goodwin, Fitton End	28·0 lb.
J. E. Sandall, Seadyke, Murrow	21·6 ,,
A. Davis, Wisbech St. Mary .	13·2 ,,
A. Hudson, Wisbech St. Mary	13·2 ,,
Wisbech (Marham) Water Co. .	4·5 ,,

Of these waters only the Wisbech Marham water is suitable for making a soft soap and nicotine spray. Apart from cost of the soft soap the amount of scum produced by these waters interferes with the working of the pump.

Experiments in Hard-water Districts.—The following experiments were next arranged to find out the most economic means of dealing with this pest in districts where the water is very hard.

Two centres, A and B, where the trees had been severely attacked by capsids in 1924, were chosen for the experiments.

Experiment A.—Messrs. Hudson & Son, Wisbech St. Mary. The plots here were sprayed as follows :—

Plot 1.—	Nicotine : (95–98 per cent.) 3¼ oz. Soft soap : 4 lb. Rain-water : 40 gal.	1st spraying only
Plot 2.—	As Plot 1	1st and 2nd sprayings
Plot 3.—	Control	Unsprayed
Plot 4.—	Sodium caseinate : 4/5th pint Nicotine : 3¼ oz. Lead arsenate : 2 lb. Dyke water : 39 gal.	Both sprayings
Plot 5.—	Lime-sulphur : 1 gal. Sodium caseinate : 4/5th pint Nicotine : 3¼ oz. Lead arsenate : 2 lb. Dyke water : 40 gal.	Both sprayings
Plot 6.—	Nicotine : 3¼ oz. Soft soap : 4 lb. Rain water : 40 gal.	2nd spraying only
Plot 7.—	Sodium caseinate : 4/5th pint Nicotine : 3¼ oz. Dyke water : 40 gal.	Both sprayings
Plot 8.—	Sodium caseinate : 4/5th pint Nicotine : 3¼ ozs. Bordeaux arsenate : 5 lbs. Dyke water : 40 gal.	Both sprayings
Plot 9.—	Soft soap : 4 lb. Lead arsenate : 2 lb. Rain water : 40 gal.	Both sprayings
Plot 10.—	Control	Unsprayed

The sodium caseinate was made on the formula :—

Commercial casein	20 oz.
Caustic soda	3 „
Water	2½ gal.

Add the caustic soda to the water and heat. While heating add the casein very gradually, stirring frequently. Boil for 10 minutes.

As shown above, the dyke water required 13·2 lb. of soft soap to soften 100 gallons of water, so that for spraying purposes 23·2 lb. of soft soap would be required for each 100 gallons of water.

Two rows of trees, alternately, Grenadier and Allington Pippin thirteen years old and rather small for their age, were chosen. Ten plots of ten trees each were thus provided, five of each variety in each plot. The spray fluids were applied by means of a barrow-type hand-power machine, the one nozzle employed

being adjusted to give a coarse driving spray. The liquid was directed mainly downwards into the blossom trusses. About 2⅔ gallons of wash per tree was applied. The first spraying was carried out on May 12, a few days before full blossoming, in bright sunny weather. The second application was made on May 22, after the fruit had set, also in very fine weather.

Counts were made of the number of shoots marked by capsids on every tree, both before and after spraying.

The only trees to bear appreciable weights of apples were the Allington Pippins on plots 1, 2, 3, 6, and 7, which were situated near each other in the southern half of the site of the experiment. The fruit was separated into four grades as follows :—

(1) Free from capsid injury.

(2) Slightly marked by capsids, i e., with up to 3 small markings.

(3) Moderately marked, i.e , with more than 3 small markings, or with one or more large marks.

(4) Badly marked, i e., distorted, misshapen, or about ¼ of whole surface marked

Apples from two adjacent control rows (X and Y) were also similarly graded. The yields and percentages in each grade are set out in Table I.

TABLE I —ALLINGTON PIPPINS

Plot and No of trees	Spray fluid	Percentages of fruit				Total weight of fruit
		Clean	Slightly marked	Moderately marked	Badly marked	lb.
Plot 1 5 trees	Softsoap, nicotine (1st spraying)	64 5	15 2	9 2	11 1	15 ¾
Plot 2 5 trees	Softsoap, nicotine (2 sprayings)	70 3	17 1	9 8	2 8	140⅛
Plot 3. 2 trees (A & B)	Control (unsprayed)	31 5	17 7	17 7	33 1	45¼
Plot 6. 5 trees	Softsoap, nicotine (2nd spraying)	50 2	22 7	21 8	5 2	57¼
Plot 7 5 trees	Sodium caseinate nicotine (2 sprayings)	69 3	16 6	5 8	8 3	69¼
Plot X 5 trees	Control	3 6	5·1	8 8	82 5	34¼
Plot Y 5 trees	Control	9·8	7 1	10 3	72 8	46

The following Table II gives particulars of (1) average number of capsid-marked shoots on the lower half of each tree before spraying, and (2) the average number of capsid marked shoots after spraying.

TABLE II.

Plot.	Average number of capsid-marked shoots per tree (lower half). May 12, before spraying.	June 5, fresh markings after spraying.
1	34	9·4
2	25	1·6
3 (2 trees) A and B	10	36
3 (5 trees) including A and B	23	48
6	44	3·75
7	27	4·6

The control plots X and Y, with 82·5 and 72·8 per cent. respectively of badly marked fruit, show clearly the potentiality for damage of the capsid bug. The two trees (A and B) in Plot 3 (control), were more free from capsids before spraying than any of the other trees, this being indicated in Table II, column 2. The amount of blossom on A and B was much above the average. One would therefore expect fewer marked apples from these than from plots X and Y.

(1) The best result was on plot 2 (soft soap and nicotine applied twice), with 70·3 per cent. clean apples.

(2) The result from Plot 7 (sodium caseinate and nicotine twice) was practically as good, with 69 3 per cent. clean, as Plot 2.

(3) Plot 1 (one spraying with soft soap and nicotine) gave the satisfactory result of 64·5 per cent. unmarked fruit.

(4) Plot 6 (one spraying with soft soap and nicotine after blossoming) gave 50·2 per cent. clean.

(5) Control Plots X and Y gave only 3 6 and 9 8 per cent. respectively of clean apples.

The observations taken, on all ten plots, of the numbers of capsid-marked shoots before and after spraying, showed that all the spray fluids used in the experiment had satisfactorily reduced the number of capsids.

Experiment B.—The plots at Mr. W. Goodwin's, Fitton End, were as follows, with two sprayings for each plot, except the controls :—

Plot 1.—Control.

Plot 2.—Sodium caseinate : 4/5th pint.
Nicotine (40-45 per cent.) 7½ oz.
Dyke Water : 40 gal.

Plot 3.—Sodium caseinate : 4/5th pint.
Nicotine : 7½ oz.
Lime-sulphur : 1 gal.
Lead arsenate : 2 lb.
Dyke water : 39 gal.

Plot 4.—Sodium caseinate : 4/5th pint.
Nicotine : $7\frac{1}{2}$ oz.
Bordeaux arsenate : 5 lb.
Dyke water : 40 gal.

Plot 5.—Control.

Plot 6.—Soft soap : 4 lb.
Nicotine : $7\frac{1}{2}$ oz.
Rain water : 40 gal.

Plot 7.—Sodium caseinate : 4/5th pint.
Nicotine : $7\frac{1}{2}$ oz.
Lead arsenate : 2 lb.
Dyke water : 40 gal.

Each plot comprised part of two rows of trees, one of Grenadier, and one of Bramley's Seedling and Emneth Early alternatively. These trees were about fourteen or fifteen years old, rather small for their age. The spraying was done on May 14 and June 15, by means of a petrol-driven engine, two nozzles being used. About $3\frac{1}{2}$ gallons per tree were applied. The dyke water required 28 lb. of potash fish oil soft soap to soften 100 gallons of water, so for spraying purposes 38 lb. of soap would be required for each 100 gallons of water. This gave a scum about 8 in. thick on the top of each barrel. Observations on the number of capsid markings for each tree of the experiment were taken before and after spraying.

The only apples produced were on the Emneth Early trees in Plots 1, 2, 3, and 6. The fruit from an unsprayed tree (X) not in the above plots but next to a tree (Y) on Plot 3 which bore a very similar number of apples, was also recorded. The apples were separated into three grades as follows :—

(1) Clean fruit.

(2) Slight to moderate capsid markings.

(3) Badly marked.

Both the above sets of experiments show that the apple capsid bug can be successfully controlled by means of sodium caseinate and nicotine, even when the water used is very hard, and that there is very little difference between the results given by this wash and soft soap, nicotine and soft water *if both mixtures are properly applied.* The soap mixture wets the tree more easily and requires rather less liquid and time per tree. The sodium caseinate has the advantage of compatibility with hard water, and is not adversely affected by the addition of lime-sulphur or lead arsenate. The quantity of spray used per tree in the above experiments was about twice as much as the average grower uses on similar trees ; but this amount is considered to

be economically sound, as it controls the capsid bug, whereas the much smaller quantity used by some growers does not. The secret of the successful control of capsids apparently lies very largely in the method of application which has been explained above.

The numbers and percentages of fruits in the three grades are set out in Table III.

TABLE III. EMNETH EARLY.

Plot and No. of trees cropping	Spray fluid	Percentages of apples			Total No. of apples
		Clean	Moderately marked	Badly marked	
Plot 1. 4 trees	Control	27·4	21·9	50·7	205
Plot 2. 4 trees	Sodium caseinate and nicotine	78·9	11·1	10·0	90
Plot 3. 5 trees	Sodium caseinate nicotine, lead arsenate and lime-sulphur	83·7	14·8	1·5	486
Plot 3.					
1 tree Y	Do.	90·8	9·2	—	327
1 tree X	Control	17·3	37·1	45·6	283
Plot 6. 2 trees	Soft soap and nicotine	81·9	14·3	3 8	133

(1) The control Plot 1 gave only 27·4 per cent. clean apples.
(2) One tree in Plot 3 (nicotine, casein, lime-sulphur, lead arsenate) bore 327 apples, of which 90·8 per cent. were clean.
(3) The corresponding tree (X in Table 3), of the next Emneth Early row (unsprayed), bore 283 apples, of which only 17·3 per cent. were clean.
(4) Five trees of Plot 3 gave 83·7 per cent. clean.
(5) Plot 6 (nicotine and soft soap) gave 81·9 per cent. clean.
(6) Plot 2 (nicotine and casein) gave 78·9 per cent. clean.

Dry Spraying.—In 1922 the following powders were tested :—

Nicotine	1 per cent.
"	2 "
Nicotine sulphate	1 "
" "	2 "

These were compared with ordinary wet spraying with soft soap and nicotine. The experiments were carried out at Mr. W. Goodwin's, Fitton End, near Wisbech, on young Grenadiers. Each plot contained seven trees and these were sprayed on May 19 just as the first blossoms were opening. About ¼ lb. of powder was used to each tree and applied with a knapsack puffer. The soft soap and nicotine wet-spraying gave a satis-

factory control of the capsid bug. The controls were badly attacked. The powdered trees were intermediate in attack between the controls and the wet sprayed trees: and the difference between the various powders was not very marked. In these experiments the powders were not satisfactory for controlling apple capsid.

The great drawback found to the use of powder sprays was that the powder in the air gets into the nostrils of the operator and caused considerable discomfort. This drawback also applies to power machines, especially on still days—which are the most suitable for applying the powder to the trees.

Summary.—Causes of the failure to control capsid bug on apples have been investigated and asigned to the following causes.

(1) *Spraying at the Wrong Time.*—The correct time to spray is after all the capsids have hatched, *i.e.*, about a week or ten days before the trees are in full bloom.

(2) *Incorrect Methods of Spraying.*—Details have already been given.

(3) *Unsuitable Water for Soft Soap and Nicotine Spraying.*—Experiments were carried out which show that with very hard waters sodium caseinate and nicotine gives a satisfactory control if properly applied.

An experiment with " Dry sprays " showed that these were not satisfactory in controlling capsid bug.

CHRYSANTHEMUM EELWORM

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IN the autumn of 1924 and spring of last year there appeared in Lancashire and Cheshire a serious disease of chrysanthemums, known locally as " rust," which was new to most growers in that area. The outbreak was first noticed in Lancashire by Mr. F. Glover, of the Ministry of Agriculture, to whom the writer is indebted for kind assistance in the location of diseased areas and in the carrying out of some of the experiments. This disease, the symptoms of which appeared to vary somewhat with different varieties, was mainly characterised by the fact that the lower leaves turned yellow at the edges. These became later a rusty brown, which gave rise to the local name above mentioned and finally died off altogether (Fig. 1). There is also

associated with these symptoms a distortion or puckering of the leaves, sometimes producing an "oak-leaf" effect (Fig. 2). The exact relationship of this distortion to the disease has not yet been determined.

This condition is due to the presence in the leaf tissue of the chrysanthemum plant of a microscopic worm known as a Nematode or Eelworm (*Aphelenchus ritzema-bosi*) which is similar in nature to those found attacking bulbs, potatoes, oats, and other crops. This pest spread very rapidly and became a source of considerable loss to growers in the two counties.

According to Stewart,* who has studied the habits and life-history of the worm, the life-cycle consists of the following stages :—

(a) That of residence in the plant, *i.e.*, in the mesophyll spaces of the chrysanthemum leaf. Nutrition and reproduction are carried on in this condition.

(b) A resting stage in the soil. The worms reach the soil in fallen leaves, and the adults survive in a partially dried dormant condition on the surface of the soil for long periods.

(c) The stage of immigration into the host plant. When revived by moisture the eelworms may be attracted to a suitable plant and wander on to it.

There now arises the question as to how a healthy chrysanthemum plant placed in soil containing these minute worms becomes infected. Stewart finds that the worm passes up the *outside* of the stem on the surface film of moisture and enters the leaves by way of the stomata, and possibly also by any existing injury. As showing that the worm does not travel *inside* the stem by way of the water-conducting vessels, plants with their stems ringed with vaseline and placed in infected soil remained free from the parasite. According to the same authority the worms may also live for a time upon the outside of the plant, usually in the leaf axils. This has been confirmed by the writer, eelworms being found on the leaves in small clusters. These clusters of worms may possibly be in the act of migration to fresh leaves or plants. High atmospheric humidity is of assistance to the movements of the eelworms as they travel in the slight film of moisture on the outside of the plant.

Many eelworms are able to withstand dessication or drying up for long periods, and are able to resume their normal life when once more moistened. Opinions differ as to the length of time the chrysanthemum eelworm can remain in the dried condition. Some writers suggest that this worm and an allied

* Stewart, F. H.: "The Anatomy and Biology of the Parasitic Aphelenchi." *Parasitology*, XIII, 1921, pp. 160-179.

[illegible]] [H. B[illegible]

Fig. 1.—Dying leaves marked X.

Pl[illegible]] [H. Britte

Fig. 2.—"A" Healthy Cutting. "B" "Oak Leaf" condition.

species from ferns can only live in the soil for about fifty days. Steiner * on the other hand asserts that he has revived this eelworm after twenty-two months' dessication.

Treatment.—It has long been known that these minute eelworms are very susceptible to heat, and succumb easily to comparatively low temperatures. This fact suggests a possible method of attacking the pest, since it is fairly obvious that it will be difficult to treat the worm successfully with chemical sprays as it is safely protected inside the tissue of the leaf.

In 1920 Ramsbottom † demonstrated the success of the warm water method of treatment on a similar eelworm attacking narcissus bulbs. A number of trials have been instituted in Lancashire and Cheshire on these lines to find a cheap and easy method of eradicating the chrysanthemum eelworm. Large numbers of cuttings of different varieties were taken from diseased stocks together with equal numbers of healthy cuttings and dipped in water of varying temperatures for different periods, afterwards being struck in clean soil free from eelworm. These experiments are still in progress, and it is too early to prophesy success. One fact, however, has arisen from the trials, and that is that chrysanthemum cuttings will not stand immersion even for so short a period as two minutes in water of a temperature above 112° F. (45° C.). The temperature mentioned by Marcinowski ‡ therefore in his suggestion that plants affected with eelworm should be immersed in water at 112° F. (50° C.) for five minutes is too high for use with chrysanthemum cuttings. Until an effective method of treatment by heat has been evolved, growers of chrysanthemums would do well to take care that cuttings are not taken from plants which have shown signs of being affected by this eelworm. Soil in which such affected plants have been grown, or which has been contaminated with dead leaves from infected plants, should not be used again for chrysanthemums. All infected plants and leaves should be burned.

Susceptibility of Varieties.—From these preliminary researches upon this eelworm it transpires that there exists among chrysanthemums a considerable variation in the degree

* Steiner, G.: "On some Plant Parasitic Nemas and Related Forms." *Jour. Agric. Res.*, Vol. XXVIII, 1924, No. 2.

† Ramsbottom, H. J.: "Further Investigations on the Eelworm Disease of Narcissus." *Gardener's Chronicle*, LXVII, No. 1739, 1920, p. 204. No. 1740, p. 218.

‡ Marcinowski, K. "Parasitisch und Semi-parasitisch an Pflanzen lebenden Nematoden." *Arb. k. Anst. f. Land. u. Forstwirtsch.*, VII, 1909, pp. 1-192.

of susceptibility to attack. The variety which so far has been found to be the most highly susceptible to the disease is undoubtedly *H. W. Thorpe.*

Owing to the courtesy of various growers in Lancashire, Cheshire and elsewhere, the writer has been enabled to compile the following list of common varieties of chrysanthemums, which shows very roughly the degree of susceptibility to attack. No immune variety has yet been discovered.

Highly Susceptible.	*Susceptible.*	*Less Susceptible.*
H. W. Thorpe.	September White.	September Glory.
Sanctity.	Polly.	Goldfinch.
Armorel.	Roi de blanc.	Crawford Yellow.
Lichfield Pink.	Valet.	Golden Glory.
Goachers (all types).	Mrs. Turner.	Baldock's Crimson.
Romance.	Crawford Pink.	Western King.
Market Red.		Phyllis Cooper.
Huntsman.		Bronze Beauty.
Favourite.		

This list was compiled according to the experiences of a number of chrysanthemum growers, and is only intended to indicate roughly the susceptibility shown by common varieties. It will probably need to be revised after a further survey.

The experiments are still proceeding and the writer will be pleased to report upon chrysanthemums suspected of eelworm attack, if sent to him, c/o. The University, Manchester.

COUNCIL OF AGRICULTURE FOR ENGLAND

The Twentieth Meeting of the Council was held at the Middlesex Guildhall, Westminster, on March 11, 1926; Mr. James Donaldson in the Chair. Lord Clinton was elected Chairman of the Council for the year 1926; Mr. Donaldson (the retiring Chairman) being elected as Temporary Chairman in the absence of Lord Clinton.

Statement by the Minister of Agriculture.—Mr. GUINNESS, in the course of his address to the Council, said that before the Government issued the White Paper on Agricultural Policy they had considered very carefully the recommendations made by the Council. With regard to the recommendation in certain circumstances of a Subsidy for Production and Employment, it had not been possible to follow it for the reasons which he then explained. With regard to Part II of the Council's Recommendations under the head of Permanent Policy, it had been possible, he was glad to say, to deal with all the important recommendations. It appeared that the economic side of Agriculture lagged behind the technical side, and there was evidence that it suffered from lack of capital. In five years there had been a 10 per cent. increase in the number of owner-occupiers, many of whom were short of working capital. The banks had done their best to deal with this development, but the grant of long term credits on land was not part of their normal function. He commended the Ministry's Report by Mr. Enfield on Agricultural Credit to the Council's careful perusal. In 1925, the five principal banks had lent twenty-six millions for the purchase of agricultural land. They could not lock up for indefinite periods money lent to them for short terms and for uncertain periods, so that the Government thought it necessary to set up an entirely new organisation which would tap a new source of capital for the purpose of this long term borrowing. The organisation which might be foreshadowed was an arrangement for the issue by a central bank of long term bonds, the proceeds of which would be lent on a system of reducible mortgages to those who were buying or had bought their land. As regards short term needs, the banking system of the country had grown up chiefly to meet the needs of joint stock enterprises. The ordinary industrial undertaking had the opportunity of borrowing money on its earning power or goodwill. There was no corresponding possibility to the farmer, apart from the disastrous method of a Bill of Sale. Farmers could not spread their output evenly over the whole year in the way that men in other industries could; they had to wait a long time while their money was outstanding. The Government was anxious to arrange for short term credits to be supplied also through the agency of the joint stock banks.

With regard to small holdings, cottage holdings, and rural housing, another of the recommendations in the Council's Report, the Minister was hopeful this Session of bringing in a measure to deal with those matters. As to land drainage, a Bill had recently been introduced suggesting various changes in existing methods. During the next five years, Parliament would be asked to vote a million pounds to be given by way of percentage grants for specified works of improvement carried out by statutory drainage authorities. In regard to field drainage, it was not possible to adopt the Council's recommendation, as it would mean in effect a subsidy to a limited number of private individuals. The Department was exploring the possibility of making compulsory the attachment of drainage plans to deeds and letting agreements; it was not in a position yet to report whether the suggestion was administratively possible.

In regard to the improvement of marketing, the Ministry was pressing forward these investigations. Eight Reports had already been published, and wool and potatoes were shortly to be dealt with in other Reports. The Egg Marketing Report had received a great deal of attention, though only about 2,300 copies had been sold. This was a very small sale in relation to the large number of egg producers interested in the matter.

A Bill for the compulsory weighing of fat cattle had been introduced as proposed by the Council At present, fat cattle were weighed at about one-third of the auction marts in the country, and it was desirable that the farmer should obtain fair play at the other marts It was the Government's intention that home produce should be included within the scope of the Empire Marketing proposals, though no details could be given at this stage of the negotiations with the Dominions. A Merchandise Marks Bill had been introduced which was a wider measure than any of its predecessors It was not proposed to include in the Bill any list of articles to which its provisions would be applied. Two Committees would, however, be set up, one for Agricultural Produce, Horticultural Produce and Fish, and the other for articles which concerned the Board of Trade The Bill proposed that competing produce should be marked in one of two ways, either as "Empire" or "Foreign," or alternatively with the name of the country of origin. The value of the measure would, however, clearly depend on the British article being so standardised and graded as to be superior to all foreign competition

As regards Agricultural Education and Research, the arrangement with the Board of Education had been revised so that the Ministry could deal with the rural education of young persons between fourteen and sixteen By education and research gradual but permanent progress in the industry could be effected Improved means of spreading the results of research were being adopted

The Minister said that a good deal of opposition had sprung up amongst the National Farmers' Union to the Ministry's proposals for the elimination of Scrub Bulls It had been seriously argued that the quality of the calf was really of no consequence to the dairy farmer It was becoming a very serious position where the long efforts of this Council and of the Ministry of Agriculture to try and improve our British livestock were in danger of being neutralised by the storm which was raised on this new method of advance It seemed quite evident that the Government could not hope for any advantage from a system of licensing bulls until agricultural opinion was solidly behind it

The Minister added that there were still sporadic outbreaks of Foot and Mouth Disease, though there was no reason to doubt that the measures taken under the slaughter policy for checking outbreaks had proved effective At this point he gave some account of the present position in regard to the disease, in the course of which he said that in several recent instances it was the case that lesions of the disease at the time of discovery of the outbreak were already several days old, so that there was no doubt that the farmers should have reported the disease earlier This was a very serious state of affairs A register of movements of livestock had been instituted, and with the exception, perhaps, of Scotland, had been well received and the Ministry believed was being properly enforced

On the question of fees in respect of certificates proving bad husbandry under the Agricultural Holdings Acts, a note had been made of the need of authority being given to County Councils to charge fees, so that a proposal to that effect could be included in the next legislation for amendment of the Acts.

In the course of questions which were put to the Minister arising out of his statement, Lord STRACHIE (Somerset) asked whether the Council would have an opportunity of expressing its opinion for the proposed distribution of the subsidy for Empire Marketing before it was adopted by the Government. The Minister said he was not in a position to give that undertaking, but he assured the Council that the matter was being weighed most carefully and that nothing would be left undone to see that agriculture got a square deal. Mr. W. R. SMITH, and Mr. J. S. GIBBONS (Gloucester) asked as to the new powers under the Land Drainage Bill, and were informed. Sir DOUGLAS NEWTON (Cambs.) raised a question as to the licensing of bulls operations in Northern Ireland. The Minister replied that the report was that the Act had been working with great smoothness. The only criticism was that the standard of bulls licensed was not high enough, but the standard had been fairly stringent seeing that in the Spring of 1925, 2,300 licences had been granted and 628 refused, while in the Autumn of 1925, 827 licences had been granted and 250 refused, *i.e.*, about 23 per cent. The working of this Scheme in Northern Ireland was in no way to be connected with any shortage of bulls for breeding. The decrease in the number of cattle in that country which was noted during 1924 and 1925—it was really before the Licensing Act came into force—was due to entirely different causes, chiefly the increased demand for stores, &c., in this country in 1924 to replace losses owing to foot-and-mouth disease.

A member raised the question of whether a smaller area than a 15-miles area could not be defined in cases of sporadic outbreaks of Foot and Mouth Disease. The Minister gave reasons why this course could not well be followed. Major S. V. HOTCHKIN (Lindsey) asked whether the area in Lincolnshire, near Horncastle, could be cut down to the actual farm buildings. The Minister said that he would look into the matter and would in this, as in all cases, remove the restrictions as soon as it seemed safe to do so.

Mr. WALTER SMITH moved a vote of thanks to the Minister for his statement, which was seconded by Mr. GEORGE NICHOLLS (Soke of Peterborough) and carried unanimously.

New Small Holdings Policy.—Mr. ACLAND, Chairman of the Standing Committee of the Council, moved the adoption of the Report from that Committee on the proposed new Small Holdings Policy of the Government. It was owing to the courtesy of the Ministry that the Council had been given early information on this matter and that the Standing Committee had been able to present a Report of this kind. Mr. Acland was sure that the Council would appreciate being taken into confidence in this way. The principal objects of the new Policy were (1) the extension of the ordinary work of providing holdings, (2) the provision of holdings expressly for applicants who desire to become owner-occupiers, and (3) the provision of cottage holdings with a quarter to three acres of land to be owned and occupied by agricultural workers. He commented separately on each paragraph of the Report, and drew attention to the fact that new schemes would be prepared by the Council and approved by the Ministry, and that the latter body would probably be prepared to pay an annual grant of a specified amount for a fixed number of years, provided the scheme were carried out by the Council on the lines of the approved estimate. The proposal which was put up for consideration was that the grant of the Government should be on the basis of £1 for every £1 the ratepayers were willing to supply. He hoped that the discussion would concentrate on two lines, first, whether the Council agreed with the Minister and the Government that it was necessary and important to proceed with an extension of the small holdings provisions and policy, and, second, whether the scheme as

outlined in the Report would really be a help in setting the movement going in a vigorous and effective way.

Mr. J. S. GIBBONS, Chairman of the Gloucestershire Small Holdings Committee, said he did not feel confident that County Councils would look with favour on putting any increased burden on their ratepayers in order to subsidise small holdings. It was very easy to criticise, but very difficult to suggest a scheme that would be generally acceptable. His suggestion of a solution which he put forward with great hesitation was that, as the Government were evidently ready to spend a certain sum of money, to allocate a proportion to each County Council and let them spend it as they wished. Major HOTCHKIN, speaking from the point of view of the Lindsey County Council, considered that his County was not in a position at the present moment to find money for the movement. The possibility of loss by County Councils was indefinite. He thought that the Government should allocate a certain proportion of this money to help to develop existing schemes, equipment for which had been retarded through lack of funds in the past. Mr. McCRACKEN (Cheshire) agreed that there must be great objection on the part of present ratepayers, particularly the existing small holders, in paying contributions to the rents of the new small holders. The only way to get over the difficulty was for the State to carry on with the provision of the cost of equipment. He thought many would be willing, as a compromise, if that sort of help were given, to drop out the question of owner-occupior small holdings. The cottage holdings proposal required a good deal of safeguarding to secure that the week-ender and other people unconnected with farming did not get the benefit. Sir DOUGLAS NEWTON pointed out that under the Land Settlement (Facilities) Act, 1919, the cost of settlement resulted in a loss of £38 per acre, and £550 per tenant. Those were terrible figures for the tax-payer to contemplate, and he felt that the only way of avoiding a great waste of money was to consult local needs and see that the best implements and plant was made available for the small holders. Mr. ROBT. GREY (Hunts) spoke on the position of small holdings as they were to-day. It was necessary first for Committees to come to such an arrangement with the Ministry as would protect the ratepayers for the next sixty or eighty years. He would ask the Minister to deal gently with County Councils in that matter. He thought that a substantial reduction would not be made in the rents of small holders in the next ten years. He suggested that the Government might say to County Councils : "You provide subject to our rule what legitimate demands there may be for small holdings after March 31, and we will provide you with money at the old rate of interest pre-war, and we will find the balance ourselves." Cheap money was in fact what County Councils wanted to assist them in this matter more than anything else. Mr. W. B. TAYLOR (Norfolk) said that the whole question would be very largely determined by the price to be paid for the land, and much anxiety and difficulty would be saved if it could be insisted that land should only be purchased at a fair and reasonable price. Mr. H. W. THOMAS (Hants) agreed with Mr. R. C. Grey that the Government should be generous with the County Councils over the prospective settlement. For the last two or three seasons, the strawberry-growers, settled under the 1918 Act, had had a disastrous time, partly owing to the competition of fruit from abroad. Some had got rid of their land. Potato and vegetable growers were also feeling the brunt of foreign competition. He considered that the small holders' industry should be safeguarded. Mr. GEORGE NICHOLLS disagreed and gave an instance of two brothers who started in 1911 with one acre each, and were now running 1,100 acres most successfully. He thought that the purchase of land for small holdings should not be pushed so

persistently; compulsory hiring was much better. He asked whether the time had not arrived when provision might be made for taking or hiring land compulsorily on a valuation. Small holders and farm workers should be given greater facilities for getting on to County Councils by the payment of part of their costs in attending meetings. Mr. WALTER SMITH said that if the provision of small holdings was to become a part of our Agricultural Policy then it should at least be upon a basis that would give some guarantee of success. He would rule out the provision of owner-occupations. He believed that a sound practical basis for small holdings would be possible on the lines foreshadowed by Mr. Nicholls. Mr. BRUFORD (Somerset) said he did not approve of the proposed new Policy and that he felt sure that his County Council would not add to its existing heavy burden by accepting the scheme. Mr. JOB LOUSLEY (Berks) said he was Chairman of the County Small Holdings Committee and could report that some of the small holders equipped before the war had done very well. In his County, land had been hired as well as bought. He was a farmer and believed in small holdings. There should be stepping-stones from the bottom to the top and everybody should have a chance. He was rather doubtful how the County Councils would come off. The Government gave one thing and took another, and it was difficult to believe that a County could bear more rates than at present. Mr. GEORGE EDWARDS dealt only with the question of the agricultural labourer and cottage holdings in the scheme. He could not understand the agricultural labourer at his present rate of wages finding the deposit to purchase his land and to build his cottage. It was not going to help the scheme if the agricultural labourer could not own his cottage except after forty years' payments. Mr. A. GODDARD said that under the Acts as they at present stood it was possible both to compulsorily hire land and to buy it at a fair and reasonable price for the purpose of small holdings. It was not the land which was the big question, but finance. There was the cost of equipment which was gradually decreasing. There was also interest. The Government had to pay 5 or 6 per cent. for its money and there was a difficulty in lending at 3½ per cent. None the less, it could be done without loss of capital. Mr. D. WOODHEAD asked how many men now-a-days could be found to venture £10 an acre on 50 acres for equipping a small holding.

Lord BLEDISLOE said he had listened with great interest to the speeches. The Ministry appreciated highly the tribute which had been paid to it for providing the Council in anticipation with the general outline of the small holdings scheme. He wished to emphasise that it was no more than an outline, and he could not consequently reply in great detail to the criticisms which had been made. It might well be that other tax-payers than agricultural ones should think the proposals impossible at the present time. The advice of the members of the Council would, however, be recorded and carefully considered by the Ministry. There appeared to him to be no present hope of obtaining either a block grant as suggested by Mr. Gibbons, or anything more than the 50 per cent. of the loss incurred on future small holdings. It should be remembered that the ex-Service men's scheme was not in any sense allied to the subject of the economic potentialities of normal small holdings. The occupying-ownership proposal appeared to have no friends, but he should make it clear that it was not proposed to force upon any applicant an occupying-ownership. In Scotland and in other countries, the provision of houses and buildings by occupying-owners had been a success and was fully justified on economic grounds. Self-help should be practised not only by the land cultivator, but by the Local Authorities. It would tend to put a premium upon extravagance if the State paid the whole of the loss incurred in the

provision of small holdings. With regard to Mr. Goddard's suggestion, Lord Bledisloe considered it to be quite obvious that the Exchequer would not agree to any scheme which involved a subsidy of something like 1½ or 2 per cent. on the capital that would be loaned for small holdings.

The Report was then formally received.

Agricultural Credit.—Mr. A. W. ASHBY, on behalf of the Standing Committee of the Council, moved the adoption of their Report which recommended to members of the Council the recently issued Report on Agricultural Credit (Economic Series No. 8), and suggested that the Council should discuss its general principles with a view to the formulation of resolutions to be laid before the Council at a future meeting. He referred to the new principle which the Report suggested viz., that the crops, or stock, or implements on the farm should be looked upon as proper security for loans of farming capital, and he discussed the proposals of the Report both in regard to Long Term and Short Term Credit. Mr. T. GREY (Warwick) considered that it was a false step to tempt farmers to borrow more money. Mr. ACLAND did not agree. It was that sort of view that was combated in the Report, which put forward the proposition that the banks, which looked after the farmer's money when he had got it, should provide credit for him when he had not. No industry thought any shame to itself to make use of the banks for credit during certain times of the year, or, indeed, on a pretty long basis. He threw out two ideas. First, he would ask the question whether the banks think that under a system of chattel mortgages they would be able to lend at the same sort of rates as they would lend on ordinary documentary security. The chattel mortgage was more expensive in the United States, where a system of supervision of farm stock might be simpler than it was in this country. With regard to long term money, he thought that the banks did not like long-term credits so much, and he wondered whether they would really be prepared to act as intermediaries between the would-be borrower and the proposed new central land bank, and that such action would be successful. General CLIFTON BROWN (West Sussex) said that it was the view of farmers as far as he could find that all should have the same facilities of buying their land as the farmers had who bought it between specified dates in two recent years under the Agricultural Credits Act, 1923. Long-term credits would also be most useful for the equipment of farms, and money should be available on reasonable terms. Farmers at present had some doubts as to how much the granting of short-term credits would disorganise the present business with merchants, dealers, and so on. The farmer would be likely to go warily in the matter. One merchant, who had a large number of farmers on his books, charged 7 per cent. for accommodation, but probably a good many cattle-dealers and others charged more. The present scheme could do much better than that. Mr. W. B. TAYLOR referred to the credit scheme in operation during the war when no less than six different persons had to sign a form recommending the grant of credit. The machinery under the present scheme should be much less formal, compatible with security. There was also need for secrecy. If a chattel mortgage, which should take precedence over all debts, was to be given to banks, it might become exceedingly difficult for the merchants, auctioneers, or other business men to make loans as they now did. The merchants, auctioneers, &c., might at least get equality of opportunity with the banks, or the industry might be more damaged than helped. Mr. GIBBONS thought there was little real need for short-term credits as farmers who had sound security could get very fair terms from the

banks at present. Farmers considered that the long term credits were probably all right and might be very useful.

Lord BLEDISLOE said that it was difficult for him to speak in any great detail, as proposals which were outlined in the Report were at present under the consideration of the Bankers' Clearing House. He thought it was generally admitted by those who had studied our agricultural system for a great many years that one of the greatest needs of agriculture was easy access to cheap credit He hoped it would be possible under the new scheme to afford to farmers who had purchased their farms, but not within the period of the two years covered by the Agricultural Credits Act, similar facilities to those provided by that Act It was also desirable to assist farmers who had arranged long term loans with banks against the contingency of their being called in Lord Bledisloe went on to discuss the position of the farmer who placed himself in the hands of local dealers, &c, in regard to short term credits Speaking generally, the Parliamentary Secretary said that there was no great industry in the country to-day which was to so small an extent conducted upon borrowed money as was agriculture, especially considering the amount of security available The value of agricultural credit was really very little understood In other countries such credit was largely provided by co-operative effort, but we appeared to be a curiously individualistic nation Under a system of chattel mortgage he hoped it would be possible to provide a form of security which would not be secret as amongst the banks, but would be secret as regards the outside world.

The Report was then received

Report on Egg Marketing in England and Wales.—Mr. ACLAND presented a Report from the Standing Committee dealing with the Ministry's Report on Egg Marketing in England and Wales, which he desired to commend warmly to the attention of members of the Council He thought that members might do worse than carry a copy or two about and show it to any keen poultry man they happened to meet The Report made some valuable suggestions for the improvement of egg marketing, and what the Standing Committee suggested was that the Ministry should issue a leaflet or leaflets summarising the main facts and conclusions of the Report It also considered that, since the business of egg-production in the country largely affected country-women, it would be an advantage if more women lecturers or demonstrators were employed by County Educational Authorities. Lord Bledisloe said that the question of the issue of a leaflet was under the consideration of the Ministry. The Report was received.

White Paper on Agricultural Policy.—Mr. R. G. PATTERSON (Staffs), on behalf of the Standing Committee, moved the following resolution:—

> That this Council, having received and considered the Government's White Paper on Agricultural Policy, regrets that, in their view, it contains nothing that will prevent the rapid conversion of arable land into grass and the consequent serious diminution of labour employed on the land

He said that he considered it a duty of the Council to take cognisance of the Government's pronouncement and to express its views upon it. Nothing would give a greater impetus to the general trade of the country than a flourishing agriculture, and he did not think that every avenue to secure that object had been explored. The responsibility for discouraging arable cultivation was a very grave one for the Government to shoulder. He had never known the position of agriculture and its prospects to be so bad as they were at the present time. Pre-war prices were obtainable for many of the products,

whilst costs were double pre-war. The creation of small holdings would not meet his objection to the present policy which provided indeed very insufficient opportunities for new men. Subsidies for agriculture had been ruled out, but were not subsidies for small holdings now being suggested? He doubted the wisdom, also, of short-term credits to a man whose business was a losing proposition. Mr. G. G. REA (Northumberland) seconded the resolution, saying that the policy would probably lead to the laying down of a great deal more grass, which would not only mean less food-stuffs but less employment for agricultural labour. The Government was giving the agricultural labourer a backhanded blow in giving him a Wages Board without at the same time giving the farmer some sort of security for employing him. It should not be beyond the powers of the Ministry to devise some means of encouraging the farmer to grow more crops and to increase the amount of labour employed. Capt. E. T. MORRIS (Herts) said that the policy of the White Paper might be summed up in these words: "We cannot make you better, but we are of opinion that we may be able to make you a little longer dying." The position was very serious; it was the interests of the life of the Nation that were at stake. What was the future, not only of the farmer, but of the blacksmith, the village shopkeeper, and all the other people who derive their daily bread from the produce of the soil? The rusting of the plough should be stopped. Mr. MATTHEWS (Hereford) gave instances of the very low prices of corn, cattle, and sheep, and increases in rates, tithe, and other costs. Mr. ASHBY said that the farmers' business policy did not appear to square with public pronouncements. In his view land was unlikely to be laid down to grass in any unusual degree. The proportion of arable land was as high now as in 1913. Farmers were as well able to face their own economic circumstances as any body of business men in the country. Mr. W. B. TAYLOR said he would like to see the resolution made wider by deleting the latter portion and substituting therefor: "bring confidence and security to the industry." Credits were no good unless the industry was a paying proposition, and corn-growing in Norfolk was not such. He did not agree, however, that the whole of agriculture was going to decay. There never was a time that called for more enterprise and pluck. Faces should be turned to the sun and the Ministry helped by counter proposals. Could not the Minister persuade the brewing industry to brew British beer from British barley, or could he not introduce a Pure Beer Bill?

THE MINISTER OF AGRICULTURE, Mr. GUINNESS, said he had listened with great interest to the debate which really amounted to a renewal of the demand for agricultural subsidies. A measure of that kind could not be justified unless its results were certain. The National Farmers' Union had said that even if the Fallows Subsidy proposed by the Council were operated, the maintenance of the present arable acreage could not be guaranteed. That, of course, was not the main reason why subsidies were turned down. The Party now in power did try to get the consent of the country to assist in protecting the great manufacturing industries, and out of the proceeds of that protection to provide a subsidy for agriculture. The country had turned that proposal down and it did not even have the support of the agricultural industry. As to the position of agriculture, that problem would be much simpler if the country were back in the old position before modern inventions had increased industrial development. There was no evidence that land was going to continue going out of cultivation. There was evidence that the bottom had been reached in regard to price. We were back on the gold standard, and he did

think it rather a rash assumption that land would be laid down to any much greater extent to permanent pasture. The Government were doing something for arable agriculture. There was the help to the sugar beet industry. There were the credit proposals. Mr. PATTERSON replied to the debate and the motion was then put to the Meeting and carried by 23 votes to 6.

Diversion of Road Fund.—Mr. J. HAMILTON (Lancs) moved on behalf of the Standing Committee the following resolution:—

> That in view of the very large and constantly increasing volume of motor traffic and of the need for adequate provision being retained for the repair and maintenance of existing roads and for the making of new roads where necessary, the Council of Agriculture for England considers that the Road Fund should be kept intact, and no moneys from it applied to other purposes than those for which they were collected.

This was seconded by Mr. WM. MCCRAKEN (Cheshire) and was spoken to by Mr. Rea, who said he did not think the resolution went far enough. He would like the Council to consider an addition to the motion as follows—"The Council further considers that the Government should largely increase the taxation of motor lorries, motor vans, charabancs, and other heavy motor vehicles which at present pay a tax altogether inadequate to the damage done to the roads." Mr. WALTER SMITH said the question was a very important one to agriculturists. He would prefer to leave the resolution as it had been moved. Not only the first class but the second class roads of the country were becoming national in their use. The Council should impress upon the Minister that it feels strongly upon this question, and that it involved a breaking of pledges, and the breaking of a policy which was vital to the industry of agriculture.

THE MINISTER said he thought it would be a dangerous principle to say that what was suitable in 1920 should, under quite different conditions, always be maintained. Under a re-distribution of the road revenue agriculturists might be much better off than they were before. Mr. Churchill's final proposals would not be published yet, but he had undertaken that for the first time the roads maintained by the Rural District Councils would get a grant, not merely for their improvement, but for their upkeep. Mr. WOODHEAD suggested that the proposed amendment might be withdrawn. The amendment was, however, put to the meeting and lost, and the original motion carried.

Agricultural Wages, Suffolk and Norfolk.—Mr. GEORGE DALLAS moved:—

> That this Council expresses its deep regret that the Minister of Agriculture has not exercised his powers under the Agricultural Wages (Regulation) Act, 1924, to ask the Suffolk and Norfolk District Wages Committees to reconsider the decision to fix a minimum wage of 28s. for a 48 hours working week, and calls on the Minister to act on his powers without delay with the object of helping to get a living wage fixed for the agricultural workers in those counties.

Mr. GEORGE EDWARDS seconded the motion, which was discussed, and Mr. Clement Smith, the Minister, Mr. Hewitt, and other members took part, the Minister explaining that he would be justified in referring the decision back to the Local Wages Committee only if new circumstances had arisen which made the recommendation unsuitable, or if it were clear that the Committee had neglected its duty. The motion was then put to the Meeting and lost.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES

Report (No. 13) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee. The Report is as follows :—

The last Report was made on November 26, 1925, and between that date and the date of the present Report there have been two meetings of the Agricultural Advisory Committee, viz., on December 9 and February 3. Two new members have been appointed to the Committee: Mr. A. W. Ashby, in place of Professor T. B. Wood, resigned, and Mr. W. P. Gilmour, in place of Mr. John McCaig, deceased.

(1) Foot-and-Mouth Disease.—At both meetings the Chief Veterinary Officer, Sir Stewart Stockman, gave details of the existing position in regard to the disease. At the Meeting on December 9, the question as to the possible introduction of infection from abroad was again examined. The Committee was informed that the Ministry's Inspectors had been instructed to give no more licences for importation of straw for manufacturing purposes. As to the disinfection of imported motor cars, it appeared that there was no direct evidence that these had brought, or were likely to bring, the disease into the country, and that an Order to cleanse them would be difficult and costly to administer. With regard to the disinfection of railway trucks after the carriage of imported hides and skins, the railway companies' estimate for this work was over £170,000 per annum, and it was agreed that the Ministry could not insist on so large an expenditure in the absence of more direct evidence. The question of the introduction of the disease in imported meat, and imported vegetables and bags and sacks containing them, was also examined, but it was not thought possible to take action at the present time.

The question was raised of the likelihood of infection being retained a long time on farms through feeding stuffs, particularly hay, becoming infected and holding the disease. It was agreed that feeding stuffs and hay on farms should be kept under quarantine for a longer period than had been customary hitherto. In regard to the question of compensation being withheld where a farmer did not immediately report the existence of disease on his farm and thereby greatly increased the risk of a large outbreak, the Committee was informed that the Ministry had no power to withhold compensation, but that, where a conviction followed upon such concealment or neglect, the farmer could and would be charged with the amount of the estimated direct damage that his concealment or neglect had caused.

(2) Compulsory Licensing of Bulls.—At the meeting on December 9, the proposed draft Bill for the compulsory licensing of bulls was discussed and approved. It was then explained that the Ministry did not propose that the Bill should apply to old bulls, but only to young bulls up to the prescribed age (ten months) at the time when the Act would come into operation (two years from the date of the Act).

At the Meeting on February 3, the Minister informed the Committee that the proposal had met with a great deal of objection from farmers, and that if the pace was forced at the present time there was great danger that instead of having centres of propaganda on the Ministry's side, they would be in opposition. In the circumstances, he had reluctantly come to the conclusion that it would be inopportune to introduce the measure at the present time, but he hoped that the attitude of farmers generally towards the scheme would change, and that it would be possible to pass the Bill with general assent at a later date. The Committee did not disagree with the Minister's view.

(3) White Paper on Agricultural Policy.—This Paper was examined at the Meeting on February 3, and it was agreed that the consideration of it be postponed until the next Meeting of the Committee when the situation with regard to the Government's Policy might be more fully unfolded and ready for discussion.

(4) Destruction of Injurious Weeds.—It was stated in Committee that the present law dealing with injurious weeds was practically impossible to operate because of the delay which necessarily took place before the Agricultural Committees could get to work. An Inspector had to be sent to the

field on receipt of a complaint, and a notice had to be served on the offender to cut and burn the weeds. By that time, seeding had usually taken place. Legislation would only be effective if it could be made an offence at all to tolerate injurious weeds on one's land. The Ministry undertook to examine the position with a view to suggesting, if possible, an amendment of the law.

(5) Improvement of Technical Work on the Farm.—The Ministry circulated a memorandum on this subject stating that discussions had taken place with the farmers' unions and the labourers' unions, and that it was hoped that an agreed scheme would shortly be evolved.

(6) Report from the Various Departmental and Other Committees.—A Report of the Proceedings of these Committees for the four months ending January 11, 1926, was received and considered by the Committee.

March 4, 1926.

APRIL ON THE FARM

J. R. BOND, M.Sc., M.B.E., N.D.A. (Hons.),

Agricultural Organiser for Derbyshire.

Seasonal Notes.—At the time of writing (mid-March) grass land looks very fresh and green; the hedge rows are nearly half in leaf, and spring seems to be close at hand. Whether forwardness in March portends a good season, or what may be the chances of a set back to the tender growth need not be discussed; ewes with lambs, and cattle out of doors are enjoying present grazing conditions; and it is rare to find arable land so dry and workable in March as it is just now. Tradition in most European countries favours a dry March.

April is ordinarily a very busy month on the farm. Live stock demand at least as much labour at this as at any time of the year: cows and most of the young cattle are still on indoor rations; and ewes, sows and brood mares, each with their respective offspring, claim additional attention. The stock breeder who has much arable land is, therefore, least inconvenienced by the demands of field operations if he has been able to clean, manure and sow a considerable part of his land in autumn or winter.

The field work typical of April includes completing the sowing of oats, barley and small seeds; harrowing and rolling winter corn; hoeing beans; harrowing and perhaps irrigating grass land with liquid manure. Early potatoes will need saddle-back or chain harrowing to destroy the small weeds which begin to germinate in April; and charlock in spring-sown corn may call for destruction either by skilful harrowing

or by the application of powdered kainit. The principal work in April, however, is the soil preparation and sowing or planting of late potatoes, mangolds, kohl rabi, kales and ox-cabbage.

Whether to drill on the flat or on the ridge is perhaps largely a matter of circumstances and equipment. Provided that the ridges are made firm enough, either by settlement or by ridge-rolling, a good plant can be obtained by this method; cleaning operations may begin earlier than is possible in flat drilling; the weeds can be better got away from the rows of plants; and the horses will walk between the ridges without the guidance of a driver at their head. The writer's preference as often expressed in these notes is for ridges, reduced before sowing by the use of a chain harrow along them.

Farmers who habitually mix 1 lb. of swede seed with each 8 lb. of mangold seed should consider the superiority of kohl rabi for this purpose. It transplants well, and hence is useful for filling up gaps, while, being smaller in the tops, it is not so likely to smother the mangolds as is the swede.

As an insurance against shortage of keep in July and August, stock farmers may well sow a breadth of either vetch mixture or marrow stem kale during this month. The first entails the less labour, but the kale will yield the greater food supply, and if not required in summer will continue to grow and provide forage for autumn or winter use. Where already established lucerne is of course valuable for this purpose. By partial soiling much can be done to cut down the feeding-stuffs bill, which is apt to absorb such a large proportion of the dairy farmer's returns.

, **Cost of Root Crops.**—If some farmers have an unduly high opinion of the feeding value of roots, others imagine the cost of production of these crops to be very much higher than it really is. There are considerable differences in cost per ton due to season, soil and especially management, all of which influence yield; but the range of variation is probably not so great as may be suggested by the fact that in one district farmers are willing to put mangolds on rail at 10s. to 13s. per ton while in another the roots are bought at 25s. to 35s. per ton and perhaps carted three or four miles home.

Estimates of costs of producing crops are always contentious, and those concerning cleaning crops such as potatoes, "roots" and marrow-stem kale are particularly arbitrary. One farmer regards roots as exceedingly expensive, owing to the amount of labour and manure they require; another points out that

if he did not grow roots he would have to clean and manure the land in some other way, generally with a less valuable yield in return. Still another view is held by many dairy farmers, who have (and for other purposes need) the horses, the men and the manure necessary for root growing: they consider that until they have found some more productive way of employing all these than in growing meadow-hay, they are well advised to continue cultivating root crops for winter feeding. As demonstrated in last month's notes there is ample evidence in favour of feeding roots to dairy cows, including high yielders.

Reliable information has been obtained recently regarding the actual cost of growing root crops. In a report concerning fourteen East Anglian farms financially recorded in the year ended Michaelmas, 1924, Mr. J. A. Venn, M.A., of Cambridge, gives the average cost of production as follows :—

Soil	*No. of Farms*	*Acreage*	*Cost per acre* £	s.	d.
Heavy	4	34	15	17	0
Medium	4	30½	15	0	0
Light	6	92½	10	0	0
Total	14	157	14	6	0

The above costs, however, do not include harvesting and storage; but on the other hand they also ignore the deductions eventually to be made for residual manurial values and for the value of the tops.

In a second report concerning six Eastern Counties farms similarly recorded in the year ended Lady Day, 1925, Messrs. Venn and Carslaw give the average net cost of 74 acres of mangolds as £12 13s. 1d. per acre. They point out that, contrary to expectation, the average cost of these roots, including harvesting and storage, was lower than the corresponding figure for the Michaelmas group. Unfortunately the reports do not record the yields per acre; but, assuming that the crops were similar to the official averages for the Eastern Counties in 1924, viz., 21¼ tons per acre, and neglecting the value of the leaves, the cost of the roots per ton was apparently 13s. 4d. in the first group and 11s. 4d. in the second.

To Dr. A. G. Ruston, of Leeds University, I am indebted for unpublished data regarding the cost of production of 1,076½ acres of root crops, mostly swedes, on a large number of

Yorkshire farms in the year 1924. The average costs under the various headings were as follows :—

	Cost per acre £	s.	d.
Rent	1	4	9
Rates		4	2¼
Standing charges	2	3	5
Seed		4	5
Manures	3	8	1
Cleaning residues			10½
Man labour	5	7	11
Horse labour	2	7	4
Tractor labour		1	11
Gross cost	15	2	11
Less cleaning residues	1	5	1
Total	13	17	10

The average yield of dressed roots per acre was 16¾ tons and the cost per ton 16s. 8d. This figure, however, includes no allowance for the feeding or manurial value of the tops or shaws, and probably some farmers would credit the crop with a greater sum than £1 5s. 1d. in respect of its cleaning effects.

It only remains to be said that the cost of the nutriment per pound of starch equivalent in the roots, even in the relatively expensive Yorkshire crops, was considerably less than that of similar nutriment then obtainable in the form of purchased meals.

The above figures do not apply to sugar beet, which is more expensive to cultivate and costly to harvest and dispose of. The gross cost per acre in 1924 on 617 acres, recorded by Bridges and Dixey and reported upon in the Ministry's Research Monograph No. 3, was £24 2s. 11½d. per acre, or £2 2s. 4d. per ton.

The Utilisation of Surplus Milk.—Milk secretion is influenced by so many factors that the dairy farmer finds it a matter of great difficulty to maintain a uniform output. He may produce 30 per cent. more milk at one season than another, and when the fluctuation is on the excess side, as it may be in the spring months, he frequently has to consider how to make use of the surplus on the farm. Several alternatives suggest themselves, and in deciding which to adopt it is advantageous to possess the data wherewith to compare the probable returns from each method of utilisation.

Surplus milk can be fed to pigs ; and, as is well known, a small allowance of this food has very beneficial effects on

their health; moreover, milk-fed pork or bacon is of high quality. The body increase attributable to the consumption of a gallon of milk, however, is small, varying from 1 lb. in young pigs to only about $\frac{1}{2}$ lb. in older animals. On the average a gallon of milk produces $\frac{3}{4}$ lb. of live pig or $\frac{3}{5}$lb. of actual carcass, worth about 7d.

Young calves produce about 1 lb. of live weight increase, or roughly $\frac{2}{3}$ lb. of veal, per gallon of milk consumed. When veal is worth 1s. 3d. a pound, the return per gallon of milk consumed is about 10d. Calculation of the value of whole milk for rearing purposes, however, is a more difficult matter. A small allowance of milk is valuable in the diet of a calf that is otherwise being reared mainly on milk substitutes. At three months old, however, the calf will make almost as good growth on half a gallon of milk, water, and 3 lb. of calf meal, costing 4d., as on $1\frac{1}{2}$ gallons of milk. In other words whole milk is worth little more than 4d. per gallon when fed in large quantities to calves for rearing.

The more remunerative methods of utilising surplus milk are those of cheese-making and cream selling or butter-making in conjunction with calf rearing.

NOTES ON MANURES FOR APRIL

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

"100 per cent. Available Phosphate."—A correspondent has asked what is the meaning of the expression "100 per cent. available phosphate" when applied to ground mineral phosphate offered as a fertiliser. There is no precise meaning, the word "availability" varying in its significance in different circumstances. The most probable meaning of this particular expression is that the whole of the phosphate could theoretically be taken up by crops over a course of years, assuming that all other conditions were favourable to good growth. This same claim could be made for all the standard artificial fertilisers, including the high soluble basic slags. It is of course unlikely that the whole of any fertiliser is used by crops; some, especially of phosphates and potash, remain fixed in the soil, some is washed away, particularly nitrogen, and, to a less extent, potash, and some is taken up by soil micro-organisms. The percentage actually recovered in the crop has been worked

out carefully for nitrogen owing to its costliness; it is about 50 per cent. in the first year in good farm conditions, but not much is recovered later. Fewer figures have been worked out for phosphates.

Bacteria in Fertilisers.—Fertilisers are periodically offered to farmers with the inducement that they contain bacteria, or food for soil bacteria, likely to increase the fertility of soil. There is no evidence that any of these bacterial cultures are worth paying for. The only things of value in a fertiliser are the fertilising constituents, nitrogen, phosphorus, potassium, and in some instances calcium, and the form in which they are present. The unit value method gives the best guidance to the value of a fertiliser to the farmer, due allowance being made for the combinations in which the ingredients exist, and the condition of the manure. These remarks do not apply to cultures for the inoculation of lucerne, the advantage of which has been proved at a number of farms by the Rothamsted workers.

Poor Growth of Wheat after Beans.—An interesting example is to hand from Warwickshire of a farm on which wheat does not do well after beans, though oats make good growth. Several causes might bring this about, but the expert who visited the farm attributed the results to a shortage of lime in the soil. This conclusion is in agreement with the composition of the bean crop and the respective lime requirements of wheat and oats. Beans remove a good deal of lime from the soil; a 30 bus. crop takes out about 30 lb. pure lime per acre, about as much as a 30 cwt. crop of meadow hay, and approximately three times as much as a 30 bus. crop of wheat, or a 40 bus. crop of barley, or a 45 bus. crop of oats. If land is already deficient in lime, therefore, a crop of beans will make matters slightly worse. Wheat is more sensitive than oats to lime shortage, and therefore begins to fail even though oats succeed.

Potassic Manures and Earliness of Potatoes.—A correspondent has raised the question whether the sulphate or the muriate of potash is the more likely to ripen the crop first. He states that in Jersey the sulphate more rapidly ripens early potatoes and asks whether this is general. So far as the writer knows the question has not been fully tested in an early potato district, though there is doubtless much experience among growers which could usefully be collected and examined. For the main crops of potatoes many experiments have been

made at Rothamsted and elsewhere, and here the tops tend to die down first on the plots supplied with muriate. This does not always seem to affect the weight of tubers per acre, but their composition is as a rule somewhat different.

Magnesian Limestone: Can it Safely be Used by Farmers?—This has recently been asked by a farmer who had been offered lime containing 6 per cent. of magnesia, and desired to know if it could safely be used on his land. There is no evidence that so small an amount as 6 per cent. could do any injury, and indeed the whole question of magnesian limestone deserves re-examination in the light of the changed conditions of modern practice. The fear of injury of magnesia dates from the time when large dressings of lime and limestone were given, but nowadays the dressings are smaller. The writer knows of only one definite experiment in this country with quantities approaching those used in modern practice; it was made at Garforth and showed no ill-effect from magnesia. More extensive experiments were made at New Jersey in the United States, but in these also there were no harmful effects. It is improbable that farmers would nowadays wish to use more than two tons of lime per acre, and experiments with quantities of this order are very desirable to see if the magnesian limestones are really as bad as they are reputed.

Manuring Barley to Deal with Frit Fly.—It has been found at Rothamsted that manuring barley with superphosphate reduces its liability to attack by frit fly. Reports from a Wiltshire farmer show that nitrate of soda has the same effect. There is no inconsistency between these results. The plant is saved by making the ear shoot quickly from its ensheathing leaves so as to be out of the path of the grub or larva when it crawls downwards after emerging from the eggs which are generally laid at the top of the leaf. If it meets the head in its path it will feed on the embryonic grain, but a head that has already shot out escapes. On typical barley soils nitrate of soda might reasonably be expected to produce this result.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending March 10				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	14 2	..	13 7	13 10	17 5
„ lime (N. 13%) ..	..	12 10	..	12 0‡	18 6
Sulphate of ammonia—					
Neutral (N. 21·1%	13 1*	13 1*	13 1*	13 1*	(N.)12 4
Kainit (Pot. 20%)	3 12	3 0	..	..	..
„ (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	..	..	3 9	3 3	3 2
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51¼%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 34%)	..	..	3 9§	3 5§	1 11
„ (T.P. 30%)	..	..	..	2 17§	1 11
„ (T.P. 28%)	..	2 8§	..	..	..
„ (T.P. 26%)	..	2 3§	..	..	..
„ (T.P. 24%)	2 9§	1 19§	2 3§	..	..
Ground rock phosphate (T.P.58%)	2 17¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 19	3 6	1 11
„ (S.P. 32%) ..	..	..	3 16	..	..
„ (S.P. 30%) ..	3 0	2 17	3 12	3 0	2 0
Bone meal (N. 3¾%, T.P. 45%) ..	8 15	8 5	8 10	7 15	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 0†	6 10†	5 15	5 10	..
Fish guano (N. 6½%, T.P. 10%) ..	..	..	..	7 17	..
Burnt lump lime	1 8	1 12	1 18	2 1‖	..
Ground lime	1 15	..	2 8	1 15‖	..
Ground limestone	1 7	..	1 4	..	..

Abbreviations: N. = Nitrogen; S.P. = Soluble Phosphate; T.P. = Total Phosphate; Pot. = Potash

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in 4-ton lots in the home counties.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are f.o.r. at Northern London Stations Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

‖ Delivered in 4-ton lots to London.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton.

MONTHLY NOTES ON FEEDING STUFFS

E. T. HALNAN, M.A.,

Animal Nutrition Institute, Cambridge University.

The Use of Sugar Beet Tops as a Substitute for Oats for Heavy Draft Horses.—In a recent number of the *Landwirtschaftliche Jahrbucher*, there appears an interesting and instructive account of the experiments carried out by Evhard Bartsch, to establish the value of sugar beet tops (without leaves) for heavy draft horses. In view of the increasing interest in sugar beet, any information on the use of sugar beet tops is of value. If sugar beet are sent to the factory in a properly topped condition, a considerable proportion of valuable feeding material is left behind on the field in the form of sugar beet tops, and this feeding material may amount in an average crop to four or five tons to the acre. It is already the practice in some districts to feed these tops to sheep, both in-lamb ewes and hoggetts having been fed on sugar beet tops without harmful effects. Indeed, in the case of the in-lamb ewes, a healthy crop of lambs were produced and the ewes gave a good flow of milk. The crowns, or tops without leaves, can be fed without stint, but more care is necessary when the leaves are fed owing to the presence of oxalic acid in them. In the case of Bartsch's experiments, only the crowns were fed. The experiment was carried out on three teams of horses, whose ages varied from seven to thirteen years, and whose average weight was 12½ cwt. The animals were divided into two groups. One group received a ration consisting of 11 lb. of rye straw, 11 lb. of meadow hay and 16½ lb. of crushed oats; the other group received 11 lb. of rye straw, 15½ lb. of lucerne hay, 9 lb. of crushed oats and 62½ lb. of sugar beet crowns. The experiment lasted for a total period of six weeks; careful estimates of the work performed by these animals during this period were made, and the results show the following facts to have been established.

(1) Sugar beet tops form a very useful food for heavy draft horses, provided that care is taken to feed them in the freshest possible condition in the form of slices, and as far as possible free from dirt.

(2) Sugar beet tops can be regarded as a substitute for oats, provided that care is taken to feed with them a protein-rich fodder such as lucerne hay, in order to supply the protein

which is lacking in the sugar beet tops. When fed under such conditions, 5 lb. of sugar beet tops can take the place of 1 lb. of oats in the ration.

Compound Feeding Stuffs.—The development of agricultural education and research has considerably extended our knowledge of the scientific principles underlying the nutrition of farm livestock, and a considerable proportion of farmers are now in the position to compound suitable rations for their livestock on economical lines, using straight feeding stuffs for the purpose. In the past, this has been done by the compound cake and meal manufacturers, who utilised such knowledge as was available to prepare proprietary foods, which were placed on the market after suitable tests had been made by them to ensure that the foods were suitable for the purpose in view. Such foods, in the majority of cases, were straightforward compounds, but were naturally more expensive than home made mixtures, owing to the fact that naturally the manufacturer required adequate payment for his services. This additional expense, combined with the tendency among the manufacturers to keep the composition of the cakes and meals a trade secret, caused the larger farmers to compound their own mixtures as soon as they had the requisite knowledge, since, not only were they in the position of feeding their stock on cheaper lines, but they also knew exactly what the animals were getting.

The small holders, however, still have to rely largely on the compound cake manufacturer for their supplies, since they do not feed enough cake and meal to enable them to buy the separate ingredients of the mixture in sufficient bulk to get them at economical rates. The position with regard to compound cakes and meals, however, has definitely changed, and manufacturers will do well to recognise this fact, as in all businesses the producer who studies and satisfies his customers' requirements eventually obtains the greatest success. The big manufacturers have already recognised this fact; they are not only taking scientific advisers on their staff, but are also anxious to consult the scientific and advisory staffs of the various Colleges and Universities dealing with agricultural investigation and research.

The process has gone one stage further in America, and eventually the same system will probably be adopted in this country. In America, the manufacturers co-operate with the advisory and research staffs by meeting them in conferences

DESCRIPTION	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British..	—	—	11 10	0 15	10 15	72	3 0	1·61	9·6
Barley, British feeding ..	—	—	7 15	0 12	7 3	71	2 0	1·07	6·2
„ Canadian No. 4 Western	28 9	400	8 2	0 12	7 10	71	2 1	1·12	6·2
„ American	27 9	„	7 15	0 12	7 3	71	2 0	1·07	6·2
„ Russian	27 6	„	7 13	0 12	7 1	71	2 0	1·07	6·2
Oats, English, white	—	—	9 0	0 13	8 7	60	2 9	1·47	7·6
„ „ black and grey	—	—	8 13	0 13	8 0	60	2 8	1·43	7·6
„ Scotch, white	—	—	9 7	0 13	8 14	60	2 11	1·56	7·6
„ Canadian No. 2 Western	28 9	320	10 2	0 13	9 9	60	3 2	1·70	7·6
„ „ No. 3 „ ..	27 6	„	9 12	0 13	8 19	60	3 0	1·61	7·6
„ „ feed	23 9	„	8 7	0 13	7 14	60	2 7	1·38	7·6
„ American	24 0	„	8 8	0 13	7 15	60	2 7	1·38	7·6
„ Argentine	22 9	„	8 0	0 13	7 7	60	2 5	1·29	7·6
Maize, Argentine	30 3	480	7 2	0 12	6 10	81	1 7	0·85	6·8
„ South African	30 3	„	7 2	0 12	6 10	81	1 7	0·85	6·8
Beans, English winter.. ..	—	—	10 0	1 11	8 9	66	2 7	1·38	20·0
Peas, „ dun	—	—	11 0	1 7	9 13	69	2 10	1·52	18·0
„ „ maple.. ..	—	—	11 13	1 7	10 6	69	3 0	1·61	18·0
Dari, Egyptian..	—	—	11 10	0 15	10 15	74	2 11	1·56	7·2
Millers' offals—									
Bran, British	—	—	6 2	1 6	4 16	42	2 3	1·20	10·0
„ broad	—	—	7 15	1 6	6 9	42	3 1	1·65	10·0
Middlings, fine, imported ..	—	—	7 12	1 1	6 11	69	1 11	1·03	12·0
„ coarse, British .	—	—	6 0	1 1	4 19	58	1 8	0·89	11·0
Pollards, imported	—	-	5 12	1 6	4 6	60	1 5	0·76	11·0
Meal, barley	—	-	9 10	0 12	8 18	71	2 6	1·34	6·2
„ maize	—	—	8 15	0 12	8 3	81	2 0	1·07	6·8
„ „ South African .	—	—	7 10	0 12	6 18	81	1 8	0·89	6·8
„ „ germ .. .	—	—	7 10	0 18	6 12	85	1 7	0·85	10·0
„ „ gluten feed ..	—	—	9 10	1 6	8 4	76	2 2	1·16	19·0
„ locust bean	—	—	9 12	0 9	9 3	71	2 7	1·38	3·6
„ bean	—	—	12 5	1 11	10 14	66	3 3	1·74	20·0
„ fish	—	—	18 0	4 1	13 19	53	5 3	2·81	48·0
Linseed	—	—	17 0	1 10	15 10	119	2 7	1·38	19·0
„ cake, English, 12% oil	—	—	13 0	1 16	11 4	74	3 0	1·61	25·0
„ „ „ 10% „	—	—	12 15	1 16	10 19	74	3 0	1·61	25·0
„ „ „ 9% „	—	—	12 5	1 16	10 9	74	2 10	1·52	25·0
Soya bean „ 6% „	—	—	11 0	2 11	8 9	69	2 5	1·29	36·0
Cottonseed cake, English, 5¼% „	—	—	6 2	1 13	4 9	42	2 1	1·12	17·0
„ „ Egyptian, 5¼% „	—	—	5 17	1 13	4 4	42	2 0	1·07	17·0
Decorticated cottonseed cake, 8% oil	—	—	10 15	2 11	8 4	71	2 4	1·25	35·0
Decorticated cottonseed meal, 7% oil	—	—	10 2	2 11	7 11	74	2 0	1·07	35·0
Ground nut cake, 7% oil .	—	—	8 10†	1 15	6 15	57	2 4	1·25	27·0
Decorticated ground nut cake, 7% oil	—	—	11 15†	2 13	9 2	73	2 6	1·34	41·0
Palm kernel cake, 6% oil .	-	-	6 10	1 2	5 8	75	1 5	0·76	17·0
„ „ „ meal, 6% oil	—		6 15	1 2	5 13	75	1 6	0·80	17·0
„ „ „ meal, 2% oil	—	—	6 0	1 3	4 17	71	1 4	0·71	17·0
Feeding treacle..	—	—	7 0	0 9	6 11	51	2 7	1·38	2·7
Brewers' grains, Dried ale ..	—	—	6 17	1 3	5 14	49	2 4	1·25	13·0
„ „ „ porter ..	—	—	6 7	1 3	5 4	49	2 1	1·12	13·0
„ „ Wet ale ..	—	—	1 5	0 9	0 16	15	1 1	0·58	4·8
„ „ „ porter ..	—	—	0 18	0 9	0 9	15	0 7	0·31	4·8
Malt culms	—	—	6 15*	1 13	5 2	43	2 4	1·25	16·0

* At Bristol. † At Hull.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of January and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. ~~Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit~~, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 8d.; P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

and agreeing upon mixtures which are considered economical and suitable for such purposes as calf feeding or milk production. The manufacturers then make up cakes and meals on this basis, and not only is the full chemical composition of the mixture declared, but in addition a full declaration of the ingredients is given. The system is a perfectly fair one; the manufacturer's clientèle increases rapidly, a fair profit is also ensured, and the purchasers have the advantage of knowing exactly what is being fed to their stock.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch equivalent	Protein equivalent	Per ton £ s.
Barley (imported)	71	6·2	7 17
Maize	81	6·8	7 2
Decorticated ground nut cake	73	41·0	11 15
„ cotton cake . . .	71	34 0	10 15

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 1·87 shillings, and per unit protein equivalent, 2·67 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1925, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	8 0
Oats	60	7·6	6 12
Barley	71	6·2	7 9
Potatoes	18	0·6	1 15
Swedes	7	0·7	0 15
Mangolds	7	0·4	0 14
Beans	66	20	8 17
Good meadow hay	31	4·6	3 10
Good oat straw	17	0·9	1 14
Good clover hay	32	7·0	3 18
Vetch and oat silage	13	1·6	1 8
Barley straw	19	0·7	1 17
Wheat straw	11	0·1	1 1
Bean straw	19	1·7	2 0

MISCELLANEOUS NOTES

Farm Wages in Scotland

THE Board of Agriculture for Scotland has published particulars of the average weekly cash wages and total earnings of agricultural workers throughout Scotland as agreed at the Martinmas Hirings 1925. The cash values of the perquisites supplied to workers are based on the same valuations as were used in the statement published in respect of the Whitsuntide Hirings 1925 except in regard to potatoes, in which case the valuation has been reduced from £4 to £3 per ton.

The particulars given of the total remuneration of Grieves and Foremen as set out in the Board's returns for Whitsuntide and Martinmas 1925 show that the average total earnings (including perquisites) were 42s. 3d. and 42s. 4d. per week respectively, which, considered in conjunction with the remarks as to the revised valuation for potatoes, indicates an increase in the weekly cash wages.

The average cash wages of married Ploughmen, Cattlemen, and Shepherds rose at Martinmas above those at Whitsuntide, and in the case of Cattlemen and Shepherds the average total remuneration also was above that for Whitsuntide. The total remuneration for Shepherds showed no change. The following table shows the averages for all three classes at the two periods where the returns are comparable:—

Class of Workers (Married).	Whitsuntide 1925			Martinmas 1925		
	Cash Wage.	Estimated weekly value of allowances.	Total.	Cash Wage	Estimated weekly value of allowances.	Total.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Ploughmen	29 11	8 5	38 4	30 3	8 1	38 4
Cattlemen	30 0	9 1	39 1	31 5	8 5	39 10
Shepherds	30 0	9 5	39 5	30 8	9 0	39 8

The average total earnings of Single Ploughmen at Martinmas were 33s. 10d. per week as compared with 34s. 8d. at Whitsuntide. The actual earnings, however, varied considerably from district to district, ranging from 27s. 6d. per week in Wigtown, and Dumfries, to 45s. per week in North East Forfar.

In case of Orramen (odd men) the average wage paid to married men was 35s. 5d. (including allowances where granted) at Martinmas against 33s. 7d. at Whitsuntide, the total earnings varying from 25s. per week in Clackmannan to 42s. per week in Renfrew.

The Commercial Potato Growing Film

THE Ministry announces that the film illustrating commercial potato growing, which has been produced by British Instructional Films, Ltd., in collaboration with the Ministry, has now been released for public display. Arrangements have been made whereby copies of the film may be hired by county authorities for agricultural education at the rate of £1 per day, one day each way for transit being allowed free of charge. The company will pay carriage one way. Copies of the film may be bought outright for £25. Further particulars can be obtained on application to British Instructional Films, Ltd., Regent Studio, Park Road, Surbiton, Surrey, to whom all correspondence with regard to hire or purchase should be addressed. Expenditure incurred by authorities on the hire of the film and of local halls suitable for its display will be recognised by the Ministry as eligible for aid under the regulations for grants in aid of agricultural education and research. Should an authority anticipate such a demand for the film as would make it more economical to buy a copy outright, the sanction of the Ministry should be obtained before the purchase is made.

Scholarships for Agricultural Workers

THE Ministry announces that under the scheme for establishing scholarships and maintenance grants for the sons and daughters of agricultural workmen and others, a number of scholarships tenable at University Departments of Agriculture, Agricultural Colleges, and Farm Institutes, are offered for award this year. The scholarships are limited to sons and daughters of agricultural workmen and of other countryside workers in similar financial circumstances, and the awards cover all reasonable expenditure involved (tuition, board, outfit, travelling, &c.).

Provided a sufficient number of suitable applicants is forthcoming, ten Class I scholarships for degree courses in agriculture or horticulture, or for the course of M.R.C.V.S. at the Royal Veterinary College; ten Class II scholarships for two-year diploma courses in agriculture, horticulture, dairying, and poultry-keeping at Agricultural Colleges, and about 120 Class III scholarships for short courses at Farm Institutes will be awarded. Forms of application and full particulars may be obtained from the Secretary, Ministry of Agriculture and

Fisheries, 10 Whitehall Place, London, S.W. 1, or locally from the offices of County Councils. The latest date for receiving applications is April 30.

The scheme was approved in 1922 for an experimental period of five years, and this is the last offer of awards under the experimental scheme. The future of the scheme will be considered after the selection of scholars for the present year has been completed.

Varieties of Potato Immune from Wart Disease

IN the report on the Wart Disease Immunity Trials carried out at Ormskirk in 1923 (see this JOURNAL, March, 1924, p. 1170) it was stated that, in addition to the varieties mentioned therein, the Ministry was prepared to include other varieties which had successfully passed the test when the growers signified their intention of introducing them into commerce.

This intention has now been notified in regard to the variety "Glasgow Favourite," and it has accordingly been added to the official list. The following is a description of this variety :—

Late or Maincrop Variety

(1) *Sprout.*—Pink.
(2) *Tubers.*—Oval, skin white ; flesh white ; eyes shallow.
(3) *Haulm.*—Upright, bushy, medium height ; leaflets small, light green, twisted ; stems bronzed ; wings serrated.
(4) *Flowers.*—White, small, numerous ; anthers pale orange.

The variety "Ben Ledi," of which a description was given in this JOURNAL for March, 1923, p. 1137, has been renamed "Perth Favourite," under which name it will in future be shown in the official list.

Clean Milk Courses for Sanitary Inspectors

IN this JOURNAL for October and December, 1925, reference was made to courses of instruction in clean milk production which had been arranged for sanitary inspectors by various provincial agricultural colleges, and mention was made of the course which had shortly before been provided at Leeds University. Arrangements have now been completed whereby all provincial agricultural colleges will provide, from time to time, these special short courses, and,

in consequence, the Ministry has prepared—in consultation with the National Dairy Research Institute—and has issued, a general scheme for such courses, including a suggested syllabus and time table. In its scope the syllabus includes lectures on the objects of the clean milk movement, general survey of the milk industry, legislation and orders, methods, equipment, and structural requirements, routine in the cowshed and milk-room, bacteria in milk, location and fitting of dairies and farm milk-room, cowshed inspection, sterilisation and steam production, combined with farm and laboratory demonstrations dealing with the routine of clean milk production in the cowshed, keeping quality test, dilutions, plating, &c., taking and dispatching of samples, and fat, acid, sediment, and reductase tests.

Since November last, courses have been held at five centres, namely :—

National Institute for Research in Dairying (acting in place of the Agricultural Department, University College, Reading). —Held from December 7 to 12 (inclusive), 1925, and attended by fifteen sanitary inspectors. The syllabus of instruction followed was similar to that detailed in the Ministry's scheme. At the conclusion of the course those who had attended expressed keen appreciation of the opportunities provided for them.

University College of North Wales, Bangor.—Held from January 4 to 9, 1926 (inclusive), and was attended by thirteen sanitary inspectors. The Ministry's syllabus of instruction was carried out with additional lectures on the elements of bacteriology and the comparative efficiency of disinfectants. Visits were made to the College Farm, the Vaynol Estate Home Farm, and to three small holdings. The course was a great success, particularly from the point of view of the younger sanitary inspectors, and all who took part felt that the results were eminently satisfactory.

Bristol University.—Held from January 18 to 30, 1926. The twelve sanitary inspectors who attended had to carry out duties in their respective districts in the mornings, and the course was therefore held in afternoons only. In addition to the main features of the Ministry's syllabus of instruction the course included visits to various farms, commencing with one where alterations for clean milk production were in progress, and finishing with one where certified milk was produced. The inspectors showed great interest in the work, and it is probable that a further course will be held shortly.

Seale Hayne Agricultural College.—Held from January 11 to 16, 1926, and attended by eleven sanitary inspectors from Devon, Cornwall, and Somerset. The course was modelled on the Ministry's syllabus with minor alterations, and excursions were arranged to typical farms producing Grade "A" and "Certified" milk, and to a dairy where bottling and retailing of Grade "A" milk is done. A general discussion was held at the end of the course, during which considerable satisfaction was expressed at the ground covered, and opinions and criticisms were offered with a view to making any further courses even more popular.

Armstrong College.—Held from January 29 to February 26, 1926, on Fridays only. The course was thus held on five consecutive Fridays, and this arrangement appears to have suited the forty-one sanitary inspectors who attended. The form of instruction included the main features of the Ministry's syllabus, together with visits to farms; a general lecture and conference concluded the course.

Provided sufficient applications for admission are forthcoming, courses will shortly be held by the authorities of the University College of Wales, Aberystwyth; the Cheshire School of Agriculture, Reaseheath; the Midland Agricultural and Dairy College, Sutton Bonnington; and the Harper Adams Agricultural College, Newport, Salop. In the furtherance of this movement both the Sanitary Inspectors' Association and its District Committees are giving their co-operation, and have already expressed the utmost satisfaction at the results achieved.

Covent Garden Laboratory

THE Department of Scientific and Industrial Research has recently established a small research laboratory in the vicinity of Covent Garden Fruit and Vegetable Market. The laboratory will work in close connection with the Low Temperature Research Station, Cambridge, which is the headquarters of the fruit and vegetables section of the department's organisation for food investigation. Problems which are beyond the resources of the laboratory can, therefore, be handed on to the station without delay. The object of the laboratory is to bring the Low Temperature Research Station into closer contact with the trade in fruit and vegetables, and with the practical aspects of the problems of their transport and storage. Covent Garden has been selected as the most suitable situation for the

laboratory because (1) fruit and vegetables can be studied there at all times of the year; (2) its supplies are derived from all quarters; and (3) it is a convenient centre from which to reach the main producing areas in the country and the chief ports to which supplies are brought from overseas. The address of the laboratory is The Covent Garden Laboratory, Dudley House, Endell Street, London, W.C. 2, and the telephone number, "Regent 6602."

Farm Workers' Minimum Wages.—Meetings of the Agricultural Wages Board were held on February 22 and March 16 at 7 Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following orders carrying out the Committees' decisions:—

Bedfordshire and Huntingdonshire.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to operate as from March 1 (when the existing rates are due to expire) and to continue until February 28, 1927. In the case of male workers aged 21 years and over the minimum rate fixed by the Order is 30s. 6d. (instead of 30s. as at present) per week of fifty hours in Summer (first Monday in March to last Saturday in October) and of forty-eight hours in Winter remainder of the year) with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays. In the case of female workers aged eighteen years and over the minimum rate is 6d. per hour.

Devon.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to operate as from March 26 (when the existing rates are due to expire) and to continue until March 25, 1927. The Order continues the present rates unchanged, the weekly minimum rate in the case of male workers aged twenty-one years and over being 32s. 6d. per week of fifty-two hours for the period between June 16 and September 30, and of fifty hours for the other parts of the year, with overtime at 8½d. per hour on weekdays and 10d. per hour on Sundays. In the case of female workers aged twenty years and over the rate is 5d. per hour for all time worked.

The Order also fixes a special rate of overtime of 10d. per hour for employment of male workers on the hay and corn harvests.

Dorset.—An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on February 28 (when the existing rates are due to expire) and to continue until February 26, 1927. The minimum rate fixed in the case of male workers aged twenty-one years and over is 30s. per week of fifty-one hours in Summer (second Monday in February to last Sunday in October) and of forty-eight hours in Winter (remainder of the year), instead of per week of 51 hours all the year round as at present, with overtime at 8d. per hour. In the case of female workers aged fifteen years and over the minimum rate is 5d. per hour, with overtime at 6d. per hour.

Essex.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to come into operation on March 1 (when the existing rates are due to expire) and to continue until October 31, 1926. The Order continues the present minimum rates for male workers unchanged, the rate for workers aged twenty-one years and over being 30s. per week of fifty hours in Summer (second Monday in February to second Sunday in November) and of forty-eight hours in Winter (remainder of the year), with overtime at 9d. per hour. In the case of female workers aged twenty-one years and over the minimum rate has been increased to 6d. per hour.

Hertfordshire.—An Order to come into operation on March 26 amending the existing Order fixing special rates of wages for male workers employed in glasshouses so as to provide that such rates should apply to male workers employed wholly or mainly in glasshouses situated in market gardens or nursery grounds or on work incidental to their employment therein. The rates in question are in the case of male workers aged twenty-one years and over with three years' experience in glasshouses 11½d. per hour, and for workers with less than three years' experience 10d. per hour, for a week of fifty-one hours in Summer (March 1 to October 31) and of forty-eight hours in winter (remainder of the year). The Order also provides a rate of an extra ½d. per hour for workers engaged in cucumber growing in glasshouses. Provision is also made for overtime at rates at 1¼ times the ordinary minimum rate except for employment after twelve noon on Public holidays when the rate is to be 1½ times the ordinary minimum rate.

Kent.—An Order continuing the existing minimum rates of wages for male and female workers with overtime on a reduced scale to come into operation on March 2 (when the existing rates are due to expire) and to continue in operation for a period of twelve months. The Order provides in the case of horsemen, stockmen, or shepherds aged 21 and over a rate of 33s. per week of 52 hours and in addition 8d. per hour for all employment on customary duties in excess of 52 hours, but not exceeding 60 hours per week. In the case of other male workers aged 21 years and over the minimum rate is 32s. 6d. per week of 52 hours in Summer (first day of March to last day of October) and of 48 hours in Winter (remainder of the year). Overtime rates for adult male workers are 9d. per hour on weekdays and 10d. per hour on Sundays. In the case of female workers aged 18 years and over, the minimum rate is 5½d. per hour with overtime at 6½d. per hour on weekdays and 7d. per hour on Sundays.

Monmouthshire.—An Order continuing the existing minimum and overtime rates of wages for male workers and minimum rates for female workers unchanged from March 16 (when the existing rates are due to expire) for a period of twelve months. The rate in the case of male workers aged 21 years and over is 32s. per week of 50 hours in Summer (first Monday in March to first Monday in November) and of 48 hours in Winter (remainder if the year), with overtime at 9½d. per hour on weekdays and 11½d. per hour on Sundays. In the case of female workers aged 17 years and over the rate is 6d. per hour.

Northumberland.—An Order fixing minimum and overtime rates of wages for male and female workers to operate as from May 13 (when the existing rates are due to expire) and to continue until May 13, 1927. The rates fixed by the new Order are in the case of male workers aged 21 years and over employed as stewards,

horsemen, cattlemen, stockmen, or shepherds and hired by the week or longer, 40s. per week of customary hours for workers who are householders and 37s. per week in the case of such workers who are not householders (as against the present rates of 41s. and 38s. respectively); a week of customary hours is defined for the purpose as not exceeding 62 hours per week. In the case of other male workers aged 21 years and over (except workers in casual employment) the rate is 33s. (instead of 34s. as at present) per week of 52½ hours in Summer (the first Monday in March to the last Sunday in October) and of 48 hours in Winter (remainder of the year). The rate for casual workers aged 18 years and over is 7½d. per hour. In the case of female workers aged 18 years and over the rates are 5d. per hour for those other than casual workers and for casual workers 3d. per hour.

Somerset.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to come into operation on April 1 (when the existing rates are due to expire) and to continue until October 1, 1926. The Order continues the present minimum rates unchanged, but a variation is made in the overtime rates. The minimum rates in the case of male workers aged 21 years and over are 32s. per week of 52 hours, and in the case of female workers aged 21 years and over, 6d. per hour. The overtime rate for male workers aged 21 years and over is in future to be 9d. per hour for all overtime employment (instead of as at present 7½d. per hour for the first hour of overtime employment and 9d. per hour for subsequent hours).

Worcester.—An Order cancelling the present minimum and overtime rates of wages for male and female workers and fixing new rates to operate as from March 22 and to continue until March 5, 1927. In the case of male workers the weekly rate as from March 22 will be on the basis of a week of 50 hours in Summer (first Monday in March to last Sunday in October) instead of a week of 53 hours as at present and of 48 hours in Winter, the weekly rate in the case of male workers aged 21 years and over being 30s. The rates for female workers remain unchanged, the rate for such workers aged 18 years and over being 4½d. per hour. Special overtime rates have been fixed for stockmen, shepherds and waggoners of 21 years and over of 7d. per hour for the first three hours of overtime in each week and 9d. per hour for all other overtime employment. The overtime rate for ordinary male workers will be increased from 8¾d. to 9d. per hour. The overtime rates for female workers remain unchanged, the rate for such workers aged 18 years and over being 5¾d. per hour.

Yorkshire East Riding.—An Order fixing special rates of wages for male and female workers for overtime employment during this year's corn harvest. In the case of male workers aged 21 years and over, not boarded and lodged by their employer, the special rate will be 1s. 3d. per hour and in that of male workers boarded and lodged the rates will be: for foremen, waggoners, beastmen and shepherds 1s. per hour and for lads 9d. per hour. The special harvest overtime rates in the case of female workers aged 16 years and over will be 11d. per hour.

Glamorganshire.—An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on March 2 (when the existing rates are due to expire) and to continue until March 1, 1927. In the case of male workers aged 21 years and over employed as stockmen, cattlemen, cowmen, horsemen,

shepherds, or bailiffs, the minimum rate is 40s. per week of 60 hours with overtime at 11d. per hour. In the case of other male workers aged 21 years and over, the new rate is 36s. per week of 50 hours in Summer (March 1 to last day of October) and of 48 hours during the remainder of the year (instead of the present rate of 37s. 6d. per week of 53 hours in Summer and 51 hours in Winter), with overtime at 10d. per hour on weekdays and 11d. per hour on Sundays. In the case of female workers aged 18 years and over, the minimum rate is 6d. per hour, with overtime at 7d. per hour on weekdays and 7½d. per hour on Sundays.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

* * * * *

Enforcement of Minimum Rates of Wages.—During the month ended March 15 legal proceedings were instituted against seven employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture.

Particulars of the cases are as follows :—

County	Court	Fines	Costs	Arrears of wages ordered to be paid	No. of workers con-cerned
		£ s. d.	£ s. d.	£ s. d.	
North Riding	Askew	1 0 0	—	9 12 5	1
Berkshire ...	Newbury......	—	3 18 0	16 4 9	3
Staffordshire	Newcastle-under-Lyme	—	4 9 0	7 13 5	1
Cornwall ...	Launceston....	2 0 0	—	16 4 7	2
Staffordshire	Wolverhampton	6 0 0	0 5 0	37 5 5	2
Salop	Oswestry......	5 0 0	2 2 6	63 0 9	4
West Riding.	Rotherham ...	10 0 0	1 17 6	25 0 0	5

Foot-and-Mouth Disease.—Since the issue of the March JOURNAL, the following outbreaks of foot-and-mouth disease have been confirmed: in Derby, 1; Gloucester, 2; Leicester, 2; Warwick, 2; Yorks E.R., 8.

New centres of disease were discovered during the month at Horseley, Gloucester, and Long Eaton, Derby.

Up to and including March 30 the number of outbreaks of disease since January 1, 1926, is 54, involving 13 counties.

* * * * *

Leaflets issued by the Ministry.—Since the date of the list given in the March issue of the JOURNAL, p. 1159, the following leaflets have been issued :—

New :—

No. 143. Destructive Insects and Pests Acts, 1877 and 1907.

Re-written :—

No. 279. Technical Advice for Farmers.

Revised :—

No. 197. Agricultural Education in England and Wales.

Amended :—

No. 151. Cleanliness in Dairying.

A New Strain of Flax Seed (J.W.S.).—The Linen Industry Research Association, whose headquarters are at Lambeg, Belfast, has succeeded, during recent years, in developing a new strain of flax seed, known as "J.W.S." seed, which produces a superior fibre to the older strains. The quantity of fibre is also greater and the staple longer; and on the average J.W.S. seed produces approximately 30 per cent. more fibre than the ordinary strains. The bulking of the new strain was taken over last year by the Flax Industry Development Society, Ltd., a Society not trading for profit, which is supported by the Ministries of Agriculture of England and Northern Ireland. The Society has now a limited quantity of seed available for sale to growers who will undertake to save the resultant seed from the crop and allow the Society the first option of purchasing it. Full particulars of the terms upon which the seed will be sold may be obtained from the Secretary, Flax Industry Development Society, Limited, The Flax Factory, Bunford, near Yeovil, Somerset.

* * * * *

British Agricultural Students in Germany.—The Ministry has been notified that the regulation whereby only agricultural students who have been engaged in practical agriculture for at least two years previously can be admitted to the examinations at German agricultural high schools and universities equipped with agricultural institutes, is also applicable to students from abroad. Proof of having engaged in agriculture for the qualifying period will have to be produced in the form of officially certified testimonials before students are admitted to the examinations. Work undertaken during the period of school education or during holidays will not be regarded as practical employment within the meaning of the regulation.

International Dairy Exhibition in Paris.—An International Dairy Exhibition will be held in Paris from May 8-23, 1926, in connection with the Seventh International Dairy Congress. It will be organised under the patronage of the Ministry of Agriculture and with the collaboration of the French Society for the encouragement of the Dairy Industry, and of the Committee of the Paris Fair. One part of the exhibition, comprising a scientific section and a display of dairy machinery and apparatus, will be open from May 8 to 23. In addition a temporary exhibition will be held from May 16 to 23; the sections will include fresh milk, butter, cream cheese, hard and soft cheese, sheep and goats' cheese. Entries from abroad will be classed according to the country of origin. Applications for entry closed on March 15.

International Dairy Congress in Paris.—The Seventh International Dairy Congress will take place in Paris under the auspices of the International Dairy Federation on May 17, 18, and 19, 1926. Individuals or bodies, *e.g.* Government departments, municipalities, societies, educational establishments, and industrial and co-operative dairy societies, may become members of the Congress and send delegates.

The programme is as follows:—

(1) Milk: (a) Production. (b) Technology. (c) Hygiene. (d) Science. (e) Legislation-Education-Associations. (f) Economics. (g) Supply of large cities.

(2) Protection of marks and names of origin in the international cheese trade.

(3) Establishment of an International Dairying Department at Brussels.

Excursions, to be arranged later, will follow the Congress.

Applications for membership should be addressed to Monsieur le Secrétaire général du Congrès International de Laiterie, 17 rue de Valois, Paris (1er).

Rothamsted Memoirs, Volume XII.—(Royal octavo, half calf, pp. 1056. Price 34s. 6d. net, inland post free, foreign postage extra.) This volume is now ready for distribution and can be obtained on application to the Secretary, Rothamsted Experimental Station, Harpenden, Herts, England. It is requested that where possible remittances be sent with order. The volume includes sixty-three memoirs, covering the period from 1922 to 1925. The edition is strictly limited.

The Imperial College of Tropical Agriculture.—The 1926-27 prospectus of this Institution, which was opened in 1922 at St. Augustine, near Port of Spain, Trinidad, contains the usual syllabus, and also the report of the Principal, Mr. H. M. Leake, for the year 1924-25. The College provides a Diploma Course for which students who have matriculated from any University within the British Empire, or its recognised equivalent, will be accepted. There is a Post Graduate Course for which the qualifying admission is the holding of a degree or diploma of any British University, University College or other academic institution approved by the Governing Body of the College. A special course, for students of approved qualifications, provides for those who cannot afford the time involved in a three years' course of study. There were eighteen Diploma, ten Post Graduate and four Special Course Students at the College in 1924-25. Research work has been rather limited, in view of the strength of the staff, but investigations have been carried out in the growing of bananas, pests of the sugar cane, cacao fertilisation and properties, cotton and tobacco growing, soil investigation, &c. The College possesses a fully-equipped sugar factory. The Governing Body are making a special appeal for £45,000 to provide a hostel for students, and an estate on which the business side of farming can be taught. Particulars as to admission, &c., can be obtained from the Secretary at the Registered Office, 14 Trinity Square, London, E.C. 3.

Rural Industries Bureau.—The report of the Bureau for the year ended March 31, 1925, refers to the establishment during the past year of Rural Industries Sub-Committees of County Councils, also the Rural Community Councils, set up by the National Council of Social Service, which have become active local organisations for the promotion of rural industries. To a large extent, the work of the Bureau has consisted in providing the information and assistance required by these local authorities ; and this work is likely to be of increasing importance in the future, especially as more counties devote their attention to rural industries and the need increases for a co-ordination of local activities. It has seemed desirable to concentrate in the first instance on those staple village trades which are closely allied and indispensable to agriculture, the chief being those of the farrier and blacksmith, the wheelwright and the saddler. A scheme is being developed, as a result of a conference convened at Maidstone by the Kent Rural Community

Council, to meet the decline in the agricultural demand for farrier's work by enlarging the openings for blacksmith's work in the direction of training as a general mechanic, able to undertake motor and engineering repairs, &c., and also in the making of wrought iron articles, such as gates, brackets, builders' ironmongery, light fixtures, &c. For this purpose it has been decided to form co-operative trading and credit societies to provide loans in suitable cases for blacksmiths and village artisans to purchase the necessary equipment and also to assist in marketing some of the products. For the training work, travelling demonstration vans, equipped with inexpensive and simple tools and plant, and some special plant, such as acetylene welding apparatus, would appear to be needed. The exhibits of wrought ironwork by village blacksmiths, which was organised by the Kent Rural Community Council and shown at the Bath and West Show and elsewhere last year, indicates one direction in which rural blacksmith's work might be supplemented. The special investigation into the rural wheelwright's trade, which has previously been referred to in this JOURNAL, is touched upon in the report; also the investigation into the present condition of small textile industries in Wales. In addition to the Report, a number of the Bureau's recent instructional leaflets have come to hand—these being No. 19, "Hints to Homeworkers on how to sell and price Handicrafts"; No. 20, "Decorated Leather Work"; No. 21, "Bookbinding"; No. 22, "Metal Repoussé"; No. 23, "Cane Basketing"; No 24, "Chip Carving"; No 25, "Raffia Work," and No. 26, "Small Power Plant for Farm and Workshop." Copies of these are obtainable from the Bureau at 258 Westminster Bridge Road, London, S.E. 1; Nos. 21 and 24 at 1d. each, Nos. 22, 23 and 25 at 2d. each, No. 20 at 3d. and Nos. 19 and 26 at 6d. each.

QUESTIONS IN PARLIAMENT

Women's Wages.—In a reply to Viscountess Astor, M.P., who asked what steps were being taken by the Minister, in view of the fact that the recently published report* of proceedings under the Agricultural Wages (Regulation) Act, shows that the Act is being administered to the prejudice of women, it was stated on behalf of the Minister that Mr. Guinness' predecessor had pointed out to the Chairmen of Committees in April last that certain incidental provisions inserted in the Orders relating to men had not been applied in the case of women, and that the Minister hoped that the special reference to the matter in the report in question will receive the careful attention of the Committees concerned (March 3, 1926).

Sugar Beet.—In reply to a question by Mr. Forrest, M.P., asking for particulars of the additional men actually engaged in connection with the Sugar Beet Industry, the Minister stated that approximately 4,700 persons were employed in the production of sugar in the Sugar Beet Factories in Great Britain during 1925-6, in addition to which over 6,000 persons found employment during 1925 in the erection of, and extensions to, Sugar Beet Factories. A certain number were also employed in the manufacture of machinery for the factories. No definite estimate can be made of the total additional number of workers employed by growers in the cultivation of sugar beet, but the Minister is trying to obtain some information on the subject (March 11, 1926).

* **Obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.2, price 1s. net.**

SELECTED CONTENTS OF PERIODICALS

Agriculture, General and Miscellaneous.

Weather and Agriculture, A. J. Henry et al.—(U.S. Agricultural Yearbook, 1924, pp. 457-558.) [551.5.]

The Increased Net Returns Possible from a More Extensive Use of Artificial Manures in the Irish Free State, *P. McGovern.* (Jour. Dept. Lands and Agr. (Dublin), xxv, 2, August, 1925, pp. 121-131.) [63,1624.]

Young Farmers' Clubs, *G. G. Esslemont.* (Scottish Jour. Agr., viii, 4, Oct., 1925, pp. 415-419.) [374.]

The Beneficial and Injurious Effects of Short-Wave Rays in Nature. *W. Kinzel.* (Int. Rev. Sci. and Pract. Agr., iii, 2, April-June, 1925, pp. 331-337.) [58.11.]

Agriculture in Holland, *J. J. L. Van Rijn.* (Int. Rev. Sci. and Pract. Agr., iii, 2, April-June, 1925, pp. 385-401.) [63(492).]

Land Reclamation and Land Improvement in the Netherlands, *J. P. Van Lonkhuyzen.* (Int. Rev. Agr. Econ., iii, 3, July-Sept., 1925, pp. 449-478.) [63.12(492)]

Field Crops.

Hay, *C. V. Piper et al.*—(U.S. Agric. Yearbook, 1924, pp. 285-376.) [63.1982.]

The Mineral Content of Pastures. Report on an investigation carried out under the direction of *W. E. Elliot, J. B. Orr,* and *T. B. Wood.* (Scottish Jour. Agr., viii, 4, Oct., 1925, pp. 349-359; Jour. Agr. Sci., xvi, 1, Jan. 1925, pp. 59-104.) [612.394; 6333.]

Soil Stabilisation · a Grassland Problem, *C. G. T. Morison.* (Scottish Jour. Agr., viii, 4, Oct , 1925, pp. 423-426) [63.11 ; 63.33(a).]

A Study of the Process of Making Clamp Silage, *A. Amos* and *H. E. Woodman.* (Jour. Agr. Sci., xv, 4, Oct., 1925, pp. 444-453.) [63.19832.]

Fruit Growing.

Experiments on the Manuring of Fruit Trees. II, *T. Wallace.* (Jour. Pomol. and Hort. Sci., v, 1, Dec., 1925, pp. 1-33+3 pl.) [63.41-16.]

Sulphur Dioxide as a Preservative for Fruit, *B. T. P. Barker* and *O. Grove.* (Jour. Pomol. and Hort. Sci., v, 1, Dec., 1925, pp. 50-60.) [664.85.]

Plant Pests and Diseases.

Meteorological Conditions and Plant Diseases, *E. J. Butler.* (Int. Rev. Sci. and Pract. Agr., iii (N.S.), 2, April-June, 1925, pp. 369-384. [551 5 ; 63.2.]

Studies on *Oscinella frit,* Linn, *N. Cunliffe* and *J. C. F. Fryer.* (Ann. App. Biol., xii, 4, Nov., 1925, pp. 508-528) [63.27.]

Insects Attacking Potatoes in North Wales, *C. L. Walton.* (Ann. App. Biol., xii, 4, Nov., 1925, pp. 529-535.) [63.27-33.]

Nettlehead in Hops, *C. A. W. Duffield.* (Ann. App. Biol., xii, 4, Nov., 1925, pp. 536-543.) [63.23.]

Steam and Chemical Soil Disinfection, with Special Reference to Potato Wart, *N. R. Hunt* and *F. G. O'Donnell.* (Jour. Agr. Res , xxxi, 4, Aug. 15, 1925, pp. 301-368.) [63.115 ; 63.24.]

Live Stock.

The Mineral Elements in Animal Nutrition, *J. B. Orr.* (Sect. M. Presidential Address delivered at the Meeting of the British Association for the Advancement of Science in Southampton, Aug. 26—Sept. 2, 1925.) [612.394.]

The Nutritive Value of Stack Silage (Rye Grass and Clover), *H. E. Woodman.* (Jour. Agr. Sci., xv, 3, July, 1925, pp. 327-333.) [63.19832 ; 63.60432.]

The Wool Industry in Scotland. Part I. Production. *J. A. McMillan.* Part II. The Wools of Scotland and Wool Manufactures. *A. F. Barker.* (Scottish Jour. Agr., viii, 4, Oct., 1925, pp. 366-376.) [63.63(41) ; 63.761(41).] ix, 1, Jan., 1926, pp. 9-20.

Fertility and Sterility in Domestic Animals, *J. Hammond.* (Journal of the Farmers' Club, Part 6, 1925, pp. 105-122.) [612.]

Veterinary Science.

Liver Fluke Disease in Sheep and Cattle, *J. H. Norris.* (Jour. Dept. Lands and Agr. (Dublin), xxv, 2, Aug., 1925, pp. 155-206.) [619.2; 619.3.]

Chronic Hæmaturia in Cattle, *J. F. Craig* and *D. Kehoe.* (Jour. Dept. Lands and Agr. (Dublin), xxv, 2, Aug., 1925, pp. 211-214.) [619.2.]

Poultry.

The Poultry Industry, *M. A. Jull, et al.* (U.S. Agric. Yearbook, 1924, pp. 377-456.) [63.65(73).]

The Composition of Poultry "Mixed Grains." Analyses of Samples offered for sale in England, Scotland, Wales and Ireland, *R. G. Linton.* (Scottish Jour. Agr., viii, 4, Oct., 1925, pp. 426-430.) [63.60433; 63.65 : 043.]

Bacillary White Diarrhœa, *F. R. Beaudette.* (Poultry Sci., iv, 6, Aug.-Sept., 1925, pp. 205-224.) [619.5(c).]

Economics.

Economy in Farm Working, *R. J. Young.* (Scottish Jour. Agr., viii, 4, Oct., 1925, pp. 382-390.) [333.1; 63.192.]

The Agricultural Argument, *D. H. Macgregor.* (Econ. Jour., xxxv, No. 139, Sept., 1925, pp. 339-397.) [338.1(42).]

Government Storage of Corn as a Precaution against Food Scarcity in War Time, *H. M. Thompson.* (Econ. Jour., xxxv, No. 139, Sept., 1925, pp. 491-493.) [338.9.]

The World Wheat Situation, 1924-25. A Review of the Crop Year. (Wheat Studies of the Food Research Inst., Stanford Univ., California, Vol. II, No. 1, Nov., 1925.) [63.311 : 31.]

The Position of Russian Agriculture, *M. N. Tcherkinsky.* (Econ. Jour., xxxv, No. 139, Sept., 1925, pp. 484-490.) [333.1(47).]

Farm Leases in Belgium, *A. Delos.* (Int. Rev. Sci. and Pract. Agr., iii, 3, July-Sept., 1925, pp. 389-437.) [333.5(493).]

Farm Credit, Farm Insurance, and Farm Taxation, *N. A. Olsen et al.* (U.S. Agric. Yearbook, 1924, pp. 185-284.) [332.71(73); 368.5(73); 336.2(73).]

Credit Aspects of the Agricultural Depression, 1920-21, *C. L. Benner.* (Jour. Political Economy, xxxiii, 1925, No. 1, pp. 94-106; No. 2, pp. 217-233.) [338.1(73); 332.71(73).]

Our Changing Land System, *Sir Henry Rew.* (Edinburgh Review, Oct., 1925, pp. 244-260.) [333.5(42).]

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NOTES FOR THE MONTH

Report on Proceedings under Section 2 of the Agricultural Credits Act, 1923, up to December 31, 1925

(1) THE Act received Royal assent on July 31, 1923.

(2) Immediately after the passing of the Act, the Ministry of Agriculture and Fisheries took steps to bring the new facilities to the notice of the farming community. Announcements were made in the Press and the Ministry issued a leaflet explaining the scope of the scheme and the procedure necessary to form a society. Arrangements were also made with the Agricultural Organisation Society to undertake work of general propaganda in agricultural districts. Special organisers were detailed for this work, and meetings were held in a large number of districts. Steps were also taken to engage the interest of agricultural co-operative societies affiliated to the Agricultural Organisation Society. This work was begun in August, 1923, and continued during the following twelve months. Grants to the Society towards defraying its expenses in this connection were sanctioned by the Treasury, the sum paid for this purpose being £5,443.

(3) A number of reports were submitted from time to time to the Ministry by the Agricultural Organisation Society, which showed that there was very little inclination on the part of farmers to take advantage of the scheme. A considerable number of inquiries were also received during this period from persons seeking additional credit facilities. To these full information in regard to the facilities available under the Act was sent, but the correspondence only confirmed the experience of the Agricultural Organisation Society.

(4) Objections arose partly from a lack of appreciation of the advantages of co-operation, and partly from the farmer's reluctance to disclose information relating to his financial position to a committee of his neighbours. There was also a feeling that the rate of interest was too high.

REPORTS OF PROCEEDINGS—CREDIT ACT

Name of Society	Date of registration	Amount of total advances by Ministry under Section 2 (2) of Agricultural Credits Act, 1923	Amount of repayments by Society	Remarks
		£	£	
Bedfordshire Agricultural Credit Society, Ltd., 18 Bunyan Road, Kempston, Beds. ..	29.1.24	—	—	Has never commenced operations
Cornwall Agricultural Credit Society, Ltd., Restormal, Lostwithiel, Cornwall ..	22.2.24	—	—	Has never commenced operations
East Hill Agricultural Credit Society, Ltd., East Hill Poultry Farm, Kemsing, Kent	3.5.24	1,732	—	—
East Sussex Agricultural Credit Society, Ltd., 197 High Street, Lewes, Sussex ..	8.7.24	340	50	—
Pillaton and District Agricultural Credit Society, Ltd., St. Odulph Cottage, Pillaton St. Mellion, Cornwall	11.8.24	—	—	Has never commenced operations
Furness and Cartmel District Agricultural Credit Society, Ltd., 3 Theatre Street, Ulverston, Lancs.	18.12.24	1,275	—	—
Arlesey and District Agricultural Credit Society, Ltd.	11.2.25	417	35	—
Addington Agricultural Credit Society, Ltd., Eldon House, Wellesley Road, Croydon	5.2.26	—	—	—
The Fur Board, Ltd., Bucklebury, Reading ..	2.2.26*	—	—	—

* Constituted a Credit Society by amendment of rules.

(5) Under Treasury regulations dated August 2, 1923, the rate of interest payable on advances made under Section 2 (2) of the Act was fixed at 5 per cent. On February 13, 1924, the Treasury agreed to reduce the rate of interest from 5 per cent. to Bank rate varying with a minimum of 4 per cent. Although this alteration caused an immediate reduction of 1 per cent. in the rate of interest, it proved to have little effect in increasing the interest taken in the scheme.

(6) With the object of enabling farmers to utilise the facilities under Section 2 of the Act for financing the purchase and distribution of lime, the Ministry prepared a scheme under which co-operative credit societies could be formed for this specific purpose. A leaflet explaining the proposal was published, and a number of meetings were arranged in various localities. Although in a few districts proposals to establish credit societies on these lines were made, no such society has actually been formed.

(7) The attached table gives particulars of the credit societies formed since the passing of the Act, including two societies registered in February, 1926.

(8) Further information in regard to the operation of Section 2 of the Agricultural Credits Act, 1923, is contained in a Report on Agricultural Credit prepared by the Ministry of Agriculture and Fisheries (Economic Series, No. 8), and published by H.M. Stationery Office, February, 1926.

Official Seed Testing Station

SOME interesting particulars of the work carried out at the Official Seed Testing Station for England and Wales are contained in the Eighth Annual Report of the Station which appears in No. 5 of the "Journal of the National Institute of Agricultural Botany," copies of which may be obtained from the Institute at Huntingdon Road, Cambridge, price 1s., or 1s. 2d. post free. The period covered is from August, 1924, to July, 1925, during which 21,894 samples were received for test. The sources of the samples, together with comparative figures for previous seasons, are as follows :—

		1924–25	1923–24	1922–23
Seed firms	Number sending samples ..	1,741	1,354	1,206
	Number of samples received	17,695	15,831	17,609
Farmers, &c.	Number sending samples ..	625	310	936
	Number of samples received	1,034	769	2,220
Public depts.	Number of samples received	3,165	2,286	1,849
Total number of Samples		21,894	18,886	21,678

It will be seen that the total number of samples received for test during 1924–25 was 3,008 greater than the previous season. Another very satisfactory feature is that the number of farmers sending samples for test showed an increase of 100 per cent., while the number of such samples was also increased by 34 per cent. An increase of 29 per cent. is also shown in the number of seed firms sending samples, and 12 per cent. in the number of such samples received. An analysis of the samples shows that they include 9,066 samples of cereals, 1,891 of pulses, 4,148 of roots and vegetables, 4,283 of clovers (including 2,267 of red clover), 2,334 of grasses, and 172 of linseed, various tree and miscellaneous seeds. The increase in the number of samples over the previous season is 30 per cent. in the case of clovers (28 per cent. being of red clover), 18 per cent. in the case of grasses, 16 per cent. in the case of cereals, and 13 per cent. in that of pulses.

A diagram giving the distribution of samples during the season shows that the number of samples received each month varied month by month as follows : August, 393 ; September, 1,106 ; October, 2,701 ; November, 1,728 ; December, 1,508 ; January, 2,750 ; February, 4,241 ; March 4,248 ; April, 1,937 ; May, 805 ; June, 262 ; July, 215.

Cereals.—As a result of the bad harvest conditions in 1924, the germination of the cereal samples, with the exception of barley, gave a lower average than that of the previous season. With wheat the average was 93·1 per cent. compared with 96·3 per cent. in 1917–24 ; with Oats the average was 91·3 per cent. compared with 93·4 per cent. ; Rye 85·2 per cent. compared with 93·2 per cent. ; and Barley 97·8 per cent. compared with 94·9 per cent. Bunt was found by a naked eye examination in 14·5 per cent. of the samples of Wheat, and Ergot in 15 per cent. of the Rye samples.

Pulses.—With the exception of Runner Beans, all the pulses showed a much lower average germination than the average in the previous seven seasons. Peas, for instance, gave an average of 83·5 per cent. as compared with 86·8 per cent. during 1917–24.

Root and Vegetable Crops.—Turnips and Swedes proved to be below the average germination of the seven preceding years, the former giving an average of 83·7 per cent. as compared with 87·6 per cent., and the latter 82·8 per cent. compared with 85·4 per cent. Mangolds gave an unchanged average of 77·1 per cent., whilst Sugar Beet was 81·6 per cent. as compared with 79·3 per cent., the average of the previous three years. Brussels Sprouts and Onions also showed a decreased average, whilst Cabbage, Broccoli, Cauliflower, Parsnip and Carrot gave a slight average increase.

Grasses.—The average germination of the Perennial Ryegrass samples dropped from 83·8 per cent. in 1923-24 to 79·9 per cent. in 1924-25, whereas the Italian Ryegrass samples increased from 84·2 per cent. to 85·2 per cent. Cocksfoot, Timothy and Meadow Fescue were lower, particularly Timothy, which dropped from 90·2 per cent. in 1923-24 to 75·2 per cent. in 1924-25. Dogstail showed a slight improvement. The percentage of samples of both Perennial and Italian Ryegrass containing 1 per cent. or over of injurious weed seeds showed a satisfactory drop from the previous season.

Clovers.—The Red Clover samples showed a heavy decrease in the average germination—from 81·6 per cent. in 1917-24 to 70·8 per cent. in 1924-25—but an improvement in the average purity—from 3·41 per cent. to 3·11 per cent. of impurities. The average percentage of impurities in the samples of English Red Clover unfortunately showed an increase of from 3·14 per cent. in 1917-24 to 4·29 per cent. in 1924-25. The Wild White Clover samples were of an average germination and purity, and it is of interest to note that the average percentage of hard seeds in these samples was 12·5 per cent. compared with 14·6 per cent. in the previous season.

The percentage of clover samples containing dodder showed a slight decrease in the case of English Red (5·3 of samples), Chilian Red (94·5 of samples), and New Zealand White (37·5 of samples), but an increase in the case of samples of American Red (11·1 of samples), New Zealand Red (20·0 of samples), and Mid-European White (12·9 of samples).

Investigations, &c.—In addition to the normal tests, the particulars of which are given at the beginning of this note, some 4,000 tests of an investigational nature were also carried out at the Station. The Report adds :—

> A considerable amount of work upon such problems as "Hard Seeds" and "Broken Growths" in Clover samples, relation of field tests to laboratory tests with peas, the occurrence of *Helmin-*

thosporium avenae (leafstripe of oats) in Oat samples, identification of the pea species and the occurrence of Bunt in Wheat samples has also been undertaken.

During the season there has been a marked increase in the number of enquiries with respect to the identification of plants and seeds, the identification of fungi occurring on seeds, and also in the number of enquiries of a general character in connection with seeds and seed analysis.

The Report also includes a copy of the papers set in the examination in the principles and practice of seed testing which was held at the Official Seed Testing Station in August, 1925.

Electro-Culture Investigations

The Electro-Culture Committee, under the Chairmanship of Sir John Snell, G.B.E., M.Inst.C.E., recently presented to the Minister of Agriculture its Eighth Interim Report, dealing with its work during 1925.* Previous reports on the work which the Committee has carried out since 1918 showed that under field experimental conditions an increased yield of 20 per cent. on the average might be expected when certain spring sown cereals were subjected to high tension discharge (10,000 to 20,000 volts) also that under both field and pot experiments electrification has accelerated reproductive growth much more markedly than vegetative growth.

Experimental Work of 1925.—As knowledge on certain fundamental points can be more rapidly and more economically obtained by means of pot-cultures and small plot experiments than by field experiments, the Committee decided that the experiments of 1925 should be confined to small scale work. Pot-culture and small plot experiments were conducted at Rothamsted Experimental Station, Harpenden, Hertfordshire, while small plot experiments were likewise conducted at Lincluden, near Dumfries. The laboratory work was carried out at the Imperial College of Science and Technology, South Kensington.

The pot experiments with Barley (Goldthorpe "pure line") conducted at the Rothamsted Experimental Station were designed to obtain further knowledge as to the stage of the plant's growth during which the discharge could most advan-

* Copies of this and previous reports can be obtained from the Secretary of the Committee, Mr. J. H. Tabor, Ministry of Agriculture, 10 Whitehall Place, London, S.W. 1.

tageously be given, and as to the effect of different strengths of current. The results of these experiments showed the consistent effect of electrification in increasing the grain yield of the Barley under test even in the absence of increased vegetative growth. Four experiments with current at low voltage (1,000 volts and under) gave results of especial interest. In one, No. LVIII, Cage experiment plus additional potential from May to July, the increase of dressed grain was nearly 21 per cent.

The small plot experiments with Barley at Rothamsted and Oats at Lincluden showed only small differences between electrified and control plots (ranging from $-8{\cdot}2$ per cent. to $+11{\cdot}2$ per cent. at Lincluden and $+0{\cdot}2$ per cent to $+10{\cdot}9$ per cent. at Rothamsted), and individually none of them was significant.

During 1925 a careful physiological study was made with a set of control and a set of electrified plants. Three significant facts were brought to light by this study, viz., electrification of the plant led to fewer sterile flowers, less seconds or shrivelled grains, and increased weight of the grain.

At the Imperial College of Science, laboratory studies on the effect on growth of air artificially ionized by the use of a radioactive substance were conducted, and, in addition, the plant was studied in an attempt to ascertain at what stage in its growth an electrical current can most usefully be applied.

General Conclusions from Recent Experimental Work.—The pot-cultures and plots from 1922 onwards have shown that in general a better result is obtained by electrification for a period less than that of the whole growing season. This was confirmed by the pot-cultures of 1925 and may be taken as established, at least for the experimental conditions employed, *i.e.*, six hours a day treatment with moderate currents. Although the second month was generally the most effective time of application, the first month's application has usually had some effect and with the plots has sometimes been the most successful. During the year an attempt was made to superimpose the effect of a second month's electrification on that of the first month by applying the discharge for the first two months. This was successful, for in the high voltage series application for such a period gave a higher yield than that for any other, viz., 20–29 per cent. increase of dressed grain.

The results obtained during the past season with low voltages continuously applied were of especial interest. Low

voltages (1,000 volts and under) produced as good results as high voltages (10,000 to 20,000) or better; if these results are confirmed in 1926 the economics of electro-culture will take on a new aspect, and field experiments on a totally different line from those conducted previously might be possible in 1927.

The marked effect of the discharge on the reproductive processes of the plant, even in the absence of increased vegetative growth, was again very obvious in the pot-culture work in 1925.

Regulation of the Use of Arsenical Sheep Dips for Sheep Scab

ALL sheep dips used for the purposes of the Orders of the Ministry, or Regulations of Local Authorities for the dipping of sheep for the prevention and cure of sheep scab, are required to be formally approved by the Ministry and to be labelled to that effect. Amongst these are dips which contain arsenic as one of their ingredients. The Ministry has ascertained that in common practice there is a risk of danger to the sheep by the use of arsenical sheep dips in cases in which sheep are required by the above-mentioned Orders and Regulations to undergo double dipping, that is to say, two dippings with an interval of not less than seven and not more than fourteen days between the dippings.

Having regard to the life history of the sheep scab parasite two dippings of this character are considered essential for the cure and prevention of scab. In order, therefore, that no obstacle should be placed in the way of the success of any policy for the eradication of scab, which involves the compulsory double dipping of sheep, the Ministry on April 20 made an Order entitled the Sheep Dips (Regulation) Order of 1926, which will come into operation on May 15, providing that "where by any Order of the Minister or by any regulations of a Local Authority made thereunder, the dipping of sheep twice in an approved sheep dip is required with an interval of not less than seven and not more than fourteen days between the two dippings, the use for the second dipping of any dip containing arsenic is hereby prohibited."

The Order further requires that on the label affixed to receptacles containing any approved arsenical sheep dip, a statement shall be included to the effect that the dip contains arsenic, and that its use for a second dipping under the above-mentioned circumstances is prohibited.

The new Order will not interfere with the use of arsenical dips by farmers for the purpose of preventing their sheep becoming fly-blown, or for the purpose of killing keds, ticks, lice, &c. The Order only purports to regulate the use of arsenical dips for the purposes of the statutory dippings required under the Sheep Dipping Orders and Regulations.

In purchasing any approved sheep dip, sheep farmers should be careful to ascertain whether it contains arsenic, and if so, to refrain from using such a dip for the second dipping in the above circumstances.

* * * * * * *

Production and Marketing of Eggs

Welsh Conference.—At a Conference on Production and Marketing of Eggs in Wales, organised by the Welsh Agricultural Organisation Society and the Agricultural Economics Department, University College of Wales, which was held in Aberystwyth on April 9 and 10, the following resolutions were proposed and passed unanimously :—

"(1) This conference realises that there is great scope for increased production of eggs and poultry in Wales, and is of opinion that in order to secure this expansion further attention to educational and experimental work is desirable on the part of the county and other educational authorities.

"(2) The conference recommends these authorities, together with the poultry committees of Welsh branches of the National Farmers' Union, to consider the following suggestions :—

"(*a*) That each county authority in Wales should endeavour to establish county egg-laying trials (such as are now in operation in many counties in England and Wales) with the aid of grants from the Ministry of Agriculture and Fisheries.

"(*b*) That in view of the necessity, not only for further and more intensive itinerant instruction in methods of producing eggs and poultry on Welsh farms, but for instruction in better methods of marketing this produce, county authorities should consider the possibility of appointing a whole-time Poultry Instructor in each county.

"(*c*) That where farm institutes are operating, an adequate poultry department should be established on lines suitable for the farm institute in each case where such a department does not already exist.

"(*d*) That in each case the work of the Poultry Instructor or the poultry department at a farm institute should be kept in close relation to the work of the National Poultry Institute which has been established for England and Wales at Harper Adams College.

"(3) That this conference appreciates the importance and value of the interest taken and the work done on the problems

of marketing by the Ministry of Agriculture, the National Farmers' Union, and the Welsh Agricultural Organisation Society.

"(4) That in view of the increasing competition of imported supplies, every possible step should be taken by producers, traders, and by those responsible for agricultural education, to improve the quality of eggs placed on the market by ensuring: (*a*) Freshness at time of sale; (*b*) Cleanliness; (*c*) A higher average weight of egg.

"(5) That the Welsh Committee of the National Farmers' Union, the Welsh Agricultural Organisation Society, and Agricultural Co-operative Societies, individual producers and traders should take such steps to improve the efficiency of marketing methods as may be necessary to secure a good reputation and demand for Welsh eggs within and without the Principality.

"That among the earliest steps that should be taken with this end in view is the introduction of national standards and grades for home-produced eggs. In this connection the conference notes with satisfaction that a Joint Committee of the National Farmers' Union and National Poultry Council is now sitting in London to formulate proposals, and further considers that any action that may be taken in Wales should as far as possible conform with these proposals."

Report from the Central Chamber of Agriculture.—At a recent meeting of the Central and Associated Chambers of Agriculture the following Report (dated March 29, 1926) from the Poultry Committee was presented:—

"(1) Your Committee have had under consideration the marketing of home-produced eggs, and are of opinion that the attention of Associated Chambers should be drawn to the importance of this question and the desirability of instituting as soon as possible the sale of eggs on a standardised basis, graded by weight, and with suitable guarantee of freshness.

"(2) Your Committee are of opinion that provision should be made for the compulsory registration of egg dealers."

* * * * * *

The Agricultural Index Number

THE general level of the prices of agricultural produce was further reduced in March, the index number declining by three points to 50 per cent. above the corresponding month of 1911-13. This is the lowest index number since the war, but in the past three years there have

been three occasions, viz., in June and October, 1923, and July, 1925, when the index number was only one point higher than last month. As compared with March, 1925, the general level of prices was this year lower by about 9 per cent., pigs, cheese and hay being the only commodities which were not cheaper last month than a year earlier.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921 :—

	Percentage increase compared with the average of the corresponding month in 1911-13					
Month	1921	1922	1923	1924	1925	1926
January	183	75	68	61	70	58
February	167	79	63	61	67	53
March .. .	150	77	59	57	65	50
April	149	70	54	53	58	—
May	119	71	54	56	57	—
June	112	68	51	58	55	—
July	112	72	53	52	51	--
August	131	67	54	59	56	—
September .	116	57	56	60	57	—
October .	86	59	51	63	53	—
November .. .	79	62	53	64	53	—
December	76	59	56	63	53	--

Grain.—Prices of wheat hardened a little during the latter half of March, but the average over the month, 11s. 6d. per cwt., was 4d. per cwt. lower than in February, and the index number fell from 60 per cent. to 55 per cent. above pre-war. The index number of barley prices was also reduced by 5 points, and this grain, which averaged only 9s. per cwt., sold at only 14 per cent. above 1911-13. Oats showed a relatively smaller reduction than wheat or barley, the average of 8s. 10d. per cwt. being 2d. per cwt. less than in February, and the index number declined by 2 points to 25 per cent. above pre-war. As compared with March, 1925, wheat was 1s. 9d., barley 2s. 6d., and oats 11d. per cwt. cheaper.

Live Stock.—There was practically no change in the prices of fat cattle or fat pigs as compared with February, but fat sheep advanced ½d. per lb. The index number for fat cattle, however, showed a decline of 4 points, as there was a rise in prices in March in the basic years, and the index figure of 43 per cent. above 1911-13 was 8 points lower than a year earlier. The rise of ½d. per lb. in the average price of fat sheep was relatively greater than the pre-war increase in March, and the index number advanced by 2 points to 52 per cent. above 1911-13. Fat sheep were, however, about 23 per cent. cheaper

than a year earlier. Prices of pigs remained at the high level of the previous two months. The index number of bacon pigs shows a reduction of 4 points as prices of these advanced in the basic years, but that of porkers remained unchanged at 89 per cent. above pre-war. Dairy cows continued to become cheaper and sold during March at about £1 5s. per head less than in February and were only 37 per cent. dearer than in March, 1911-13. The demand for store cattle was not very active last month and prices were lower, but the trade for store sheep improved and prices advanced. Both store cattle and sheep were cheaper than in March, 1925, especially the latter. Store pigs, on the other hand, as a result of the much higher prices of fat pigs, were considerably dearer than last year, but, although prices advanced slightly during March, the increase was relatively smaller than in March, 1911-13, and the index number declined by 6 points.

Dairy and Poultry Produce.—The average price of milk delivered to London and Birmingham was unchanged in March, but in the Manchester area there was a slight reduction, so that the index number for milk declined by 2 points to 72 per cent. above 1911-13. Butter was ½d. per lb. cheaper than in February, the decrease being in practically the same ratio as in the basic years, while cheese was unchanged on the month. The index number for cheese was 77 per cent. above 1911-13 or 20 points higher than in March, 1925, but butter at 46 per cent. above pre-war was 12 points lower than last year. Eggs at 1s. 2½d. per dozen were relatively much cheaper than in February, being only 41 per cent. above March, 1911-13, whereas in February they sold at 72 per cent. above February, 1911-13. In March, 1925, eggs were 49 per cent. above pre-war.

Other Commodities.—Supplies of potatoes on the markets continued heavy and prices have declined week by week since the beginning of February, the aggregate decrease in the two months being about 17s. 6d. to over £1 per ton. At the end of March first quality King Edwards sold at an average wholesale price in the large towns of only a little over £6 per ton, and during March potato prices were only 31 per cent. above 1911-13. Carrots continued very dear at 2½ times the pre-war price, and cabbage advanced to 90 per cent. above the basic years. Hay prices were unchanged on the month, but as there was a decrease in March in the basic years, the index number showed an advance of 2 points, though hay remained at very little above pre-war figures.

THE UTILISATION OF SUGAR BEET BY-PRODUCTS

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Sugar Beet Tops.—It is computed that something like 5 tons of sugar beet tops per acre, including about 1 ton of crowns, remain on the field after removal of the roots. The question arises as to the best means of utilising these residues. A casual answer to this inquiry might favour ploughing them into the soil, mainly with the object of avoiding further trouble. A search through the Continental nutritional literature of the last two decades, however, reveals the fact that the Germans, especially during the war-years when they were hard pressed for feeding stuffs, have devoted considerable attention to the question of the utilisation of sugar beet tops for feeding purposes. This fact alone warrants that the subject should receive careful consideration in this country. Moreover, further encouragement is derived from a study of the composition and nutritive value of sugar beet tops. The data given in Table I have been taken from a series of analyses which have been made in Cambridge during recent years.

TABLE I.

COMPOSITION OF SUGAR BEET TOPS (ON BASIS OF DRY MATTER).

	Per cent.
Crude protein	17·52
As true protein	13·83
Crude oil	2·27
Carbohydrate	53·25
Total sugar	12·55
As cane sugar*	10·66
Fibre	8·86
Ash	18·10
Sand	3·29
Moisture in fresh tops	84·05

* It should be explained that in the chemical sense beet sugar and cane sugar are one and the same substance. It is customary to refer to the product from both sources as cane sugar.

The figures given in Table I show that beet tops are to be regarded as an extremely watery food, and on an average are found to contain no more than about 15 per cent. of dry matter. The dry substance, however, is very rich in protein and carbohydrate. Nearly one-quarter of the carbohydrate is present in the form of sugar, the amount of this valuable constituent being largely dependent on the proportion of crown to leaf in the tops. As with most green fodders, the content of crude oil is small, this fraction being composed

almost wholly of chlorophyll and waxy materials of no feeding value. A noteworthy feature of the data is the low figure for fibre, the tops in this respect being sharply distinguished from the coarse fodders. The ash content is remarkably high. The average figures of several German investigations show that beet tops may contain as much as 29 per cent. of ash, including about 16 per cent. of sand. Although the tops themselves are rich in mineral salts, the high figure for ash arises mainly as a consequence of contamination with earth which adheres to the leaves in the field. This circumstance may give rise to difficulties when feeding the tops to stock.

Broadly speaking, the tops show in respect of chemical composition a closer resemblance to a succulent immature green forage than to a roughage like hay. It may be concluded that a fodder whose dry matter contains more than 17 per cent. of crude protein and nearly 13 per cent. of sugar is not to be despised by the stock-feeder. This view is strengthened by the results of German investigations (Honcamp, 1916)* into the digestibility and nutritive value of sugar beet tops, which have demonstrated that the organic matter of the tops is digestible to the extent of 79 per cent. Employing Honcamp's results to calculate the nutritive value of the sample of tops referred to in Table 1, it is found that 100 lb. of the dry matter of the sample has a feeding value equal to 54 lb. of starch. This represents a very satisfactory nutritive value, higher than that of the best quality meadow hay, which has a starch equivalent of about 50 lb. per 100 lb. of dry matter.

In respect of the nutritive properties of sugar beet tops, Kellner† states: "Liberal feeding with sugar beet tops, which is often done during and after harvesting of the beets, has the same effect as with good pasture or clover feeding, and gives a milk richer in dry matter and fat because of the quantity of protein in the feed." When a farmer decides to feed the tops, he is thereby enabled to continue the use of green fodder in the rations of his animals well into late autumn.

When feeding beet tops to stock, three points should be borne in mind :—

(1) The mineral salts contained in the tops include those of oxalic acid, which may be present to the extent of 4 to 5 per

* Honcamp, Gschwender and Mullner, Versuchs-Stationen, Vol LXXXVIII, p. 305, 1916.

† Kellner, *The Scientific Feeding of Farm Animals*, p. 345.

cent. of the dry matter. Though oxalic acid may be consumed in small amounts by animals without ill effects, larger amounts may produce grave symptoms and even result in death. The danger is not so great with ruminants, however, since the fermentations which go on in the paunch lead to a partial destruction of the oxalic acid. Nevertheless, Kellner advises feeding precipitated chalk (¼ lb. to 250 lb. beet leaves) with beet tops, with the object of rendering the oxalic acid entirely insoluble.

The danger is greatest when feeding the absolutely fresh tops, since during wilting or storage changes occur in the leaves which result in a very material reduction of the oxalic acid content. It may be assumed that the risk is negligible when the ensiled tops are fed to ruminants, a statement which is borne out by experience gained in investigations carried out at Cambridge.

(2) Beet leaves have a laxative effect on the animal, and should on that account never be fed alone, but with hay or chaff. According to Kellner, one-third of the rations of the dairy cow may be composed of beet tops, while bullocks may receive rather more.

(3) A serious difficulty in feeding beet tops may arise from the presence of adhering earth and sand. These may exert an irritant effect on the lining of the digestive tract, and may further lead to the introduction of undesirable soil bacteria into the body. Reasonable care, however, during the topping of the beets enables this difficulty largely to be overcome. The tops should be shaken vigorously to remove adhering soil, and should be gathered straightway into heaps instead of being allowed to strew the ground. Before feeding it is desirable that any soil still adhering to the leaves should be washed off.

Where it is possible to collect and cart the tops for feeding to dairy cattle, little difficulty should be experienced in observing the precautions discussed above. The simplest and most usual form of utilisation of the beet tops, however, consists in allowing sheep to eat them off the land. By this means, the trouble and expense of carting are avoided, and the return of manurial residues to the soil is assured. It should be remembered in this connection that the leaves, on account of their sappy nature, have a tendency to decompose fairly readily. When decomposition begins, feeding should be discontinued and the remainder of the tops should be ploughed in. The writer has met farmers who have kept sheep on the

tops, apparently without harmful results, for some months after topping the beet crop; but this is in general an unsafe procedure, and the feeding of the tops after decomposition has set in is not to be recommended.

It may be inferred that when a farmer decides to feed the tops to stock, he will feed as large a bulk as possible in the fresh or slightly wilted condition; since, however, only a relatively small part can be dealt with in this way, the question arises as to whether the remainder should be preserved or ploughed in. During normal times, the farmer might be inclined to adopt the latter course, but during times of food scarcity (*e.g.*, in war-time) it is desirable that the entire supply of tops should be utilised for feeding.

In Germany, two methods are in vogue for preserving sugar beet tops, namely, artificial drying and ensilage.

Artificial Drying of Sugar Beet Tops.—Of the two methods of preservation, artificial drying is perhaps the better, since it avoids the large losses of nutrient matter which frequently accompany the ensiling of a very wet crop. Artificial drying, however, cannot usually be carried out by the farmer, since the drying of such wet material is a very troublesome business. This process is undertaken in Germany by the large sugar beet factories, and several methods for drying the tops have been patented in recent years. One of these processes may be described briefly.

The drying apparatus consists essentially of a large iron trough in which a perforated sheet metal drum revolves. The drum is provided with a number of paddle-like ladles on its surface; these catch up the leaves and distribute them over the surface of the drum. A device in the upper part of the machine prevents the material from forming into lumps. Hot air is passed into the drum and through the perforations, thus coming into contact with the leaves.

In other drying apparatuses, systems of revolving knives reduce the tops to a state of fine division during the drying process. At some factories, a proportion of sugar beet slices (up to 70 per cent.) is mixed with the tops during drying, giving rise to a popular Continental feeding stuff known as beet hay.

An advantage in these drying processes is that it has been found possible to remove a large proportion of the earth which adheres to the tops in the field. The artificially-dried product consists of coarse particles of stalk, leaf and crown, and contains no dusty material. It is slightly moist to the touch

and possesses a pleasant baked smell. In respect of nutritive value, it differs from fresh beet tops solely in regard to the digestibility of its protein constituent, the protein of the dried product being digested by animals to the extent of 50 per cent. as compared with 80 per cent. for the protein of the fresh tops. This depression of protein digestibility is attributed to the influence of the high temperature during drying. The colour of the product varies from greenish-yellow to greyish-brown.

Ensilage of Sugar Beet Tops.—It is not necessary to cut the tops for purposes of ensilage. They may be ensiled whole, provided care be exercised to ensure tight packing. Normally, the tops would be preserved in pits or clamps, but in recent investigations carried out by the writer, in conjunction with Mr. A. Amos,* small wooden stave silos have been used.

In an initial trial, whole sugar beet tops, which had been left in the field a number of days exposed to the effect of variable weather, were ensiled during November. On opening the silo in the following March, silage of very good quality was found. It possessed a fragrant, appetising smell, with no suggestion of pungency or unpleasantness arising from the formation of butyric acid. It was slightly sour to the taste and had retained the colour of the fresh tops. Chemical investigation showed that the fermentation had proceeded in the directions associated with the production of good silage. In composition, it displayed the characteristics of the fresh tops, the main differences arising from the splitting up of protein into simple digestive products, and the production of organic acids from carbohydrate, changes which always occur during ensilage of a green crop.

During preservation, however, the crop suffered large losses of nutritive constituents, no less than 28 per cent. of the organic matter and 39 per cent. of the carbohydrate disappearing. These excessive losses were partly the result of juice drainage owing to compression of the wet crop, the juice carrying off a large amount of soluble food material. In a further test, however, it was found that the drainage losses could be very materially reduced by ensiling the tops mixed with wheat chaff, the latter soaking up the expressed juice which would otherwise have been lost. The ensilage of such a mixture leads to further advantages. The chaff provides the fibrous food with which beet tops should in practice

* Unpublished work.

be fed. The farmer is thus enabled to utilise not only beet tops, but also large quantities of chaff. It is further probable that the chaff gains in digestibility as a consequence of the changes occurring during ensilage. It should be added, however, that the quality of the silage resulting from the mixture of tops and wheat chaff was not so good as that of the silage obtained from sugar beet tops alone.

In a third trial, a common Continental practice was followed in ensiling alternate layers of beet tops and wet sugar beet pulp. In this way a fragrant smelling silage was obtained which was eaten readily by stock. It contained 84·6 per cent. of moisture, and analysis showed that its dry matter contained 16·3 per cent. of crude protein, 51·2 per cent. of carbohydrate and 15·5 per cent. of fibre. A digestion trial was carried out with the material, two sheep each consuming with relish and without waste about 12 lb. of the silage daily. The organic matter was found to be digestible to the extent of about 81 per cent., while 100 lb. of the dry substance of the fodder proved equal to nearly 65 lb. of starch. These figures suffice to demonstrate the satisfactory nutritive value of silage made from a mixture of tops and pulp.

The following general conclusions may therefore be drawn in regard to the utilisation of sugar beet tops. Fresh tops constitute a feeding stuff of good feeding value, and, when certain precautions are observed, are suitable for feeding to stock. In times of food scarity, there should be no question of ploughing the tops into the land. All that cannot be fed in the fresh or slightly wilted condition should be preserved. Artificial drying of the tops is a process which can only be carried out in the factory, but ensiling, with or without wet beet pulp, can be done successfully. The writer has no personal experience of ensiling the tops in the pit or clamp. This is a common practice on the Continent, however, and it may therefore be assumed that a satisfactory preservation is possible by this method.

Manurial Value of Sugar Beet Tops.—Only a limited number of analyses are available at the present time for enabling the manurial value of the beet tops to be calculated. The figures given in Table II represent the average results of the analysis of three samples of tops from crops of sugar beets grown on the University Farm at Cambridge.*.

* Unpublished observations.

TABLE II.

MANURIAL CONSTITUENTS OF SUGAR BEET TOPS (ON BASIS OF 15 PER CENT. DRY MATTER CONTENT).

	Per cent.
Nitrogen	0·40
Phosphate (P_2O_5)	0·13
Potash (K_2O)	0·70
Lime (CaO)	0·30

It will be noted that the tops are particularly rich in potash constituents. Assuming the unit prices obtaining in March of the present year, the following values are obtained :—

	Manurial value	
	Per ton.	Per acre*
	s. d.	s. d.
When ploughed in	7 3	36 3
When consumed by stock	4 3	21 3

Sugar Beet Pulp.—By sugar beet pulp is meant the residue of the sugar beet after extraction of the sugar. In the fresh condition it contains 90-95 per cent. of water, but this may be reduced to 85-87 per cent. by pressing. It is obtained in a shredded condition and readily acquires a slight musty odour. The composition of beet pulp is shown in Table III and, for purposes of comparison, corresponding figures for mangolds are given.

TABLE III.

COMPOSITION OF SUGAR BEET PULP AND MANGOLDS (ON BASIS OF DRY MATTER).

	Sugar Beet Pulp Per cent.	Mangolds Per cent.
Crude protein	10·75	8·33
Crude oil	0·76	0·83
Carbohydrate	64·83	78·34
Fibre	19·62	5·83
Ash	4·04	6·67
Moisture in fresh material	85·62	89·00

There is a general similarity in composition between beet pulp and mangolds except in regard to the fibre content, pulp being much richer in fibre than roots. From the feeding standpoint, beet pulp may be regarded as being interchangeable with roots in the ration. It owes its nutritive properties almost entirely to carbohydrate, and though it contains only about 1 per cent. of sugar on the dry matter basis, yet the remainder of the carbohydrate, consisting largely of pectic substances, is highly digestible and of good feeding value.

Sugar beet pulp may be fed in the fresh condition, or may

* Assuming 5 tons of tops to the acre.

be preserved by the processes of drying or ensiling. The cost of transport prohibits the use of wet beet pulp except on farms in the vicinity of sugar beet factories. Large numbers of steers and sheep are fattened annually with the help of beet pulp at the sugar beet factories of the Western States of America, where one ton of pulp is looked on as being equal to 200 lb. of corn for fattening lambs. Dairy cows consume the wet pulp with relish and yield a milk of good flavour, provided it is fed in not too large quantities. The beet pulp should be balanced with hay and concentrates to compensate for its deficiencies in protein and mineral constituents and, of course, roots should not be included in the ration. Care should be exercised in the use of wet beet pulp, as it tends to spoil rapidly on exposure to air. For this reason it is frequently preserved in silos or pits, with or without beet tops. Ensilage of such wet material results, however, in excessively large losses of valuable nutrients, and, therefore, the alternative method of preservation by artificial drying is to be preferred. This is carried out in the factory by the use of steam or furnace gases.

The dried beet pulp can be stored over long periods. It is a popular feed on the Continent and in America, and is now meeting with a ready sale in this country. Where big allowances are given in the ration, the pulp should be soaked before feeding, in which process it takes up more than twice its weight of water. Satisfactory results have been obtained when it has been fed to fattening bullocks and pigs. With animals receiving heavy allowances of mixed protein concentrates, a little pulp may be included in the ration with advantage, since it lightens the mass of concentrate and has a laxative effect, thus preventing digestive troubles. In respect of nutritive value, 1 lb. of dry pulp may be regarded as being equal to about 8 lb. of mangolds.

Beet Molasses.—The residue remaining after the crystallisation of the beet sugar is known as molasses. The latter may contain 15-25 per cent. of water and about 66 per cent. of carbohydrate, which consists mainly of cane sugar together with a small amount of a second sugar called raffinose. The crude protein constituent consists largely of nitrogenous substances possessing little or no feeding value, the amount of true protein being only about 0·5 per cent. The ash ingredient is particularly rich in potash, but contains almost no phosphate and very little lime.

If fed to animals too liberally, molasses has a purgative effect owing to its high content of alkaline salts. Its uses for rendering chaff more palatable and in the making of molasses feeds are well known. It is frequently mixed with beet pulp, the mixture after drying being known as molasses-beet pulp. On the Continent, molasses frequently forms the starting point for the preparation of a number of valuable by-products. By the use of special forms of yeast, it may be fermented to alcohol. After removal of the alcohol by distillation, the residue, known as beet vinasse, contains nearly the whole of the potash and part of the nitrogenous material of the original molasses. By means of the so-called " Buel " process, the beet vinasse may be utilised for the production of potash fertilisers, sulphate of ammonia and cyanide of potash.

Heriot* records the fact that in Germany during 1904 nearly 3 million gallons of 95 per cent. alcohol were produced from beet molasses. The same writer states that in 1907 one German firm alone produced cyanide of potash from beet vinasse to the value of £80,000 and sulphate of ammonia to the value of £20,000. It may be that the prosperity of the sugar industry in this country, and incidentally of the farmers who take up the growing of the sugar beet, will largely be bound up with the energetic exploitation of methods for the production of such by-products. Similar considerations have frequently been the determining factor in the successful prosecution of other important industrial processes.

THE DEVON CLOSEWOOL BREED OF SHEEP

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THE hilly district of North Devon has, for its area, most remarkable variations in both soil and climatic conditions. In the more favourably situated districts and river valleys stock fattening is carried on, but the majority of farms have a high proportion of temporary and permanent pasture with stock breeding and rearing as the mainstay.

One of the most noted stock breeding districts in Devon lies between Barnstaple, South Molton, and Blackmore Gate, and this is the home of the Devon Closewool breed of sheep

* T. H. P. Heriot: *The Manufacture of Sugar from the Cane and the Beet* (Longmans, Green & Co., 1920), p. 376.

while from the adjoining parishes, on the Eastern borders of this area, the Devon breed of cattle originated.

Origin of the Devon Closewool Breed.—The Devon Closewool originated through the blending of Devon Longwool and Exmoor Horn blood. Horns and Longwools are numerous in Devon and Somerset, the former on Exmoor and the surrounding districts, while the Longwools are adapted to the more fertile land.

It is interesting to note that the Devon Closewool breed can be traced back to local types, which were improved through the work of "Bakewell of Dishley," by the fact that Low in 1845 recorded the Devon Longwool to have been produced by crossing the improved Leicester with the Southern Notts from westward of the Vale of Honiton, and with the Bampton Notts from the borders of Devon and Somerset.

Cause of Origin.—The Closewool type has been kept for many years on the medium or down lands of North Devon, *i.e.*, farms that would maintain a somewhat heavier breed than the Exmoor Horn. Most probably the real home of the breed is in the three adjoining parishes of East Buckland, West Buckland and Charles, an area of typical downland. In this district—and on land of similar type under the name of Mongrels or Buckland sheep—the breed rapidly gained in popularity, and when further large areas of upland pasture were improved by manuring they were found to carry a heavier and earlier maturing breed of sheep. At the same time the public demand for smaller joints, and the higher price obtained for the finer wools, stimulated the breeding of this type and their entry into the lowlands. Apart from the demand for "Closewool Breeders" (draft ewes for fat lamb production) at the autumn sales, it was found that the breed produced a heavier fleece, and this encouraged the use of Closewool rams in Exmoor Horn flocks. The first cross ewe lambs were retained in the flocks and again mated to a Closewool, and to this method of breeding most probably the Closewools chiefly owe their origin.

Purity of the Breed.—A number of flocks have been bred as Closewools for many years; one breeder claims to have used only Closewool sires in his flock for over thirty years, but, as with other breeds, variations can only be reduced under the care of the Breed Society which was formed in January, 1923.

Rams from the old established flocks stamp their characteristics markedly and command high prices at sales. Messrs.

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FIG. 1.—Devon Closewool Ram

Photo.] [*C. Balment & Son*

FIG. 2.—Devon Closewool Ewes and Lambs

Photo.] [*C. Balment & Sons*

FIG. 3.—Pen of Devon Closewool Ewes

Burgess of Charles, Skinner of Bratton Fleming, Brooks and Yeo of Arlington, Fry of Stoke Rivers, and Cook of Filleigh, were some of the earliest breeders responsible for the evolution of the breed and the gradual fixing of type.

Economic Qualities of the Breed.—The Devon Closewool is undoubtedly of the rent-paying type, adaptable, thriving well on poor high land, on rich grazing land, or when folded on roots, and possessing the characteristic hardiness of the Exmoor Horn. The fleeces from rams average from 12 lb. to 14 lb., ewes clip from 8 lb. to 11 lb., the wool commanding a better price than that from Longwools. The ewes are excellent mothers, the lambs are strong when dropped, and little cake or corn is necessary for fattening them unless the land is very heavily stocked. The following weights of lambs have been obtained from a prominent breeder :—

Single lamb 10 weeks old, having had no concentrated feeding, 43 lb. dressed. Twin lambs under 10 weeks old, with concentrated feeding, 30 and 33 lb.

Hoggs without forcing will attain 18 lb. per quarter at 9 months old, but an average carcass at 12 months is approximately 60 lb.

The lamb and mutton are noted for thick fleshy joints, of high quality, with a good leg well fleshed to the hock, and popular for the London trade. Fat lambs, at an early age, kill over 50 per cent. carcass to live weight. The railway companies have provided slaughter houses near several stations, and from the slaughter house at Barnstaple, controlled by the North Devon Farmers, Limited, an average of about 25,000 carcasses are sent to London annually.

Points of the Breed.—The aim of the breeder has been to produce a sheep that would breed true to type, without the characteristics of either Exmoor Horn or Devon Longwool, and it is now claimed that this object has been achieved.

The size of the breed is intermediate, but in characteristics it could be described as a large polled Exmoor Horn, the colour of the face and legs being ivory white as in the Exmoor.

The wool, which is a distinctive feature of the breed is, as the name suggests, very close, hard to the grip of the hand, medium length of staple, and finds a ready market. The other distinctive features are :—

MALE : Masculine in appearance, nose broad and dark, ear short and thick, crown of head well covered, good bone, legs short, standing well with broad deep chest, back straight and wide, ribs well sprung, with big thigh and tail.

EWES : The ewes should possess the qualities of the male without the masculine appearance.

Annual Sales.—The Breed Society organise annual sales of breeding stock at Bratton Fleming, Barnstaple, South Molton, and Blackmore Gate. Such sales usually take place between the middle of August and mid-September.

Management of a Closewool Flock.—The management of the flocks will naturally vary in detail according to the variations in altitude, but the following is the custom on typical breeding farms :—

> During late autumn and winter the ewes run over pastures and stubbles without any additional feeding, maintaining themselves in good condition. When running very thickly, a few yellow fleshed turnips are carted out daily on the pasture, and hay may be given in exceptionally bad weather. Whenever possible the sheep are wintered near a root field. Speaking generally ewes do not receive turnips until a short period before the lambing season commences.

The rams are usually turned out with the ewes about October 1, but the date is determined by the prospective keep available at lambing time and according to the weather conditions likely to prevail at the given altitude during the lambing period. The primary object of the flock is not the production of early fat lambs, but breeding stock. Lambing starts in February and continues through March. On the most exposed farms it may be late March or even early April. Housing at this period is seldom necessary as the lambs when born are usually strong and vigorous, and the ewes milk exceptionally well. The ewes and lambs are grazed on new seeds or pastures saved during the winter, in order to get a sweet bite, and this is supplemented by swedes or mangolds. Trough feeding, either before or after lambing, is seldom practised. All lambs are docked, and with the exception of those intended for stock ram lambs are castrated when about fourteen days old. Whenever preference for pasture is considered this is given to ram and wether lambs during spring and summer, so that they may be well grown for the autumn sales. Shearing takes place in June, and it is customary to clip both ewes and lambs, but washing prior to clipping is never done. After weaning in July the lambs go on rape and clover aftermath to keep them steadily improving for the autumn sales.

Drafting from the Breeding Stock.—Culling takes place at weaning time, and the young ewes not for sale are turned on to the commons or the poorest pasture. Some farms have common rights of rough grazing, and this provides an excellent opportunity to send part of the stock away for a few months.

The grass at home freshens while the young ewes improve with the change of pasture. The ewes are drafted from the flocks as " six tooths " after their second crop of lambs, if the number of yearling ewes is sufficient to bring the flock up to standard again.

Young sound ewes of this type are in great demand either as foundation stock for new flocks, or as breeding stock for the fat lamb trade. This enables all the younger ewes to be retained without depreciating in value. The young ewes are successfully used for the production of breeding stock, but are less valuable for producing early fat lambs as they lamb rather late and have not then attained their full milking capacity.

Sale of Wether Lambs.—The wether lambs are usually sold at the autumn sales and go to the arable districts for fattening on roots, or to be finished early off grass in the following spring.

Management of Ewe Lambs.—After the autumn sales, ewe lambs have preference of keep on the farms for their first winter, but when a farm is very heavily stocked these lambs are frequently sent out to keep on grass and turnips in the arable areas, under conditions similar to those under which they would have been wintered at home. On favourably situated farms, these hoggs, when twelve to fourteen months old and well grown, will breed quite satisfactorily, and will lamb down in late March or early April.

Management of Fat Lamb Flocks.—The fat lamb industry is carried out on the better types of land in the more favourably situated districts. The ewe flock is maintained by the annual purchase of draft ewes from the breeding farms, and ewes are retained as long as their mouths keep sound.

Although pure Closewools are commonly used for this trade, crossing with Down breeds is practised very considerably. The Suffolk, Hampshire, Shropshire, Southdown, and Ryeland cross all give excellent results, but when crossing with any comparatively large-headed breed like the Hampshire, more attention may be required at lambing time, though a very fine lamb results from the cross.

On the more favourably situated farms the ewes keep fat during the winter without any additional feeding, and lambing commences in January. The ewes and lambs are put on any available fresh grass, though Italian Ryegrass is particularly valued on account of its early growth; sheltered pastures

are saved, and meadows are watered in order to obtain an early bite. In addition, late sown swedes, yellow turnips, kale and cabbage are provided. Trough feeding is a more common practice than on breeding farms, especially for the early lambs, but large numbers of single and twin lambs are sold fat without concentrated feeding when good first year clover leys or vetch mixtures are available. Many farmers rely on the first year leys before laying them up for hay to fatten the lambs. Even for this trade it is a growing practice to dock and castrate the lambs ; there is much to commend it, and with the later lambs there are many advantages in the practice. The greater proportion of these lambs go to the London markets, either through dealers or the local slaughter houses. The ewes to be drafted from the flock are sold fat and the remainder kept for another season.

HOME AND FARM CANNING OF ENGLISH FRUITS

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FRUIT canning has not yet been developed to any appreciable extent in England. A certain amount of home-grown fruit is bottled, but the canned fruit consumed in the average home is as a rule purchased from the stores, and is more often than not of foreign origin. The canning of fruit in this country even on a commercial scale is only in its infancy, and canning in the home is practically unknown. The latter is largely due to the difficulty of soldering, which for an unskilled person is rather a difficult process and has prevented home canning from becoming popular. The old-fashioned can, which was used to a limited extent during the war, is what is called the "hole and cap" can (Fig. 2). The aperture in the can was small, making it difficult to put the fruit into the can. It was a difficult can to seal, and long practice was necessary in order to become efficient.

This disadvantage has now been overcome by the introduction of a hand can-sealing machine, which may be used to close open-ended or so-called sanitary cans (Fig. 3) without the use of solder. Such cans are easily washed and packed with fruit. They are sealed on the commercial scale by power seamers, and in the home by means of a hand machine (Fig. 1.).

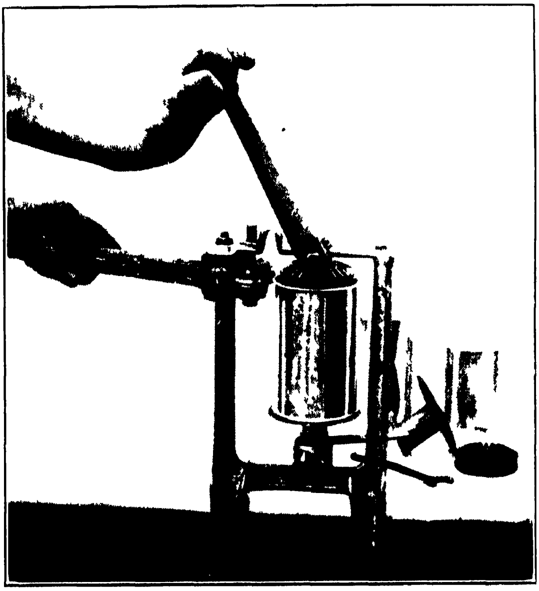

FIG. 1. Hand Power Can Sealing Machine.

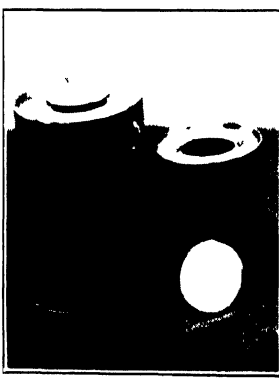

FIG. 2. Hole and Cap Can.

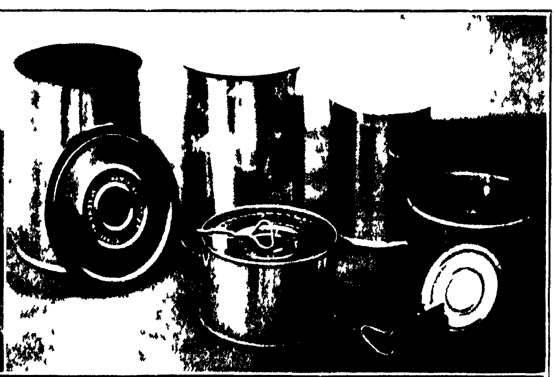

FIG. 3. Open-ended or Sanitary Cans.

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Hand can-closing machines have been in use for some years in the United States, and during the last two fruit seasons, British-made models have been thoroughly tested at the Campden Research Station. Experience has emphasised the fact that, unless the variation in depth of the cans falls within extremely narrow limits, unsatisfactory seals are made. Moreover, any dents in the flange of the can need to be removed if good results are to be secured. Suitable cans and machines are now being made in England, and there is no reason why home-canning should not become popular, since householders will find the preservation of fruit easy to carry out, and allotment-holders and small growers who cannot afford power-driven can-closing machines are provided with a new outlet for their fruit when market prices are unfavourable. Tests have been carried out at this Research Station with most of the English fruits, and satisfactory results have been obtained by the methods referred to.

In common with other methods of preservation the process of canning depends for its success upon efficient sterilisation of the contents of the can. Fruit has yeast cells upon its surface, and very often the spores of moulds. These microscopic cells are always present in the atmosphere, and it is due to their presence that the fruit goes mouldy or ferments when it is allowed to get over-ripe. Spoilage may also be due to the activities of the enzymes in the fruit, which bring about ripening changes, finally causing the fruit to rot. Putre factive bacteria are seldom found in fruits, as the acidity of the fruit prevents their development. Thus, in preserving fruit in cans, we are only concerned with killing the yeasts, moulds, and bacteria already present, and with preventing their access again to the container. This is attained by sterilising the fruit by means of heat after the can has been rendered air-tight. In canning, the closing is completed before sterilisation, thus making it impossible for micro-organisms to enter after the product has been sterilised.

Canning Operations.—*Grading.*—It is necessary to emphasise that a really first-class product can only be secured by carefully grading the fruit before it is placed in the cans. Uniformity in ripeness, evenness in size, and colour should be aimed at. Inferior fruit should not be mixed with sound fruit. Low-grade fruit may be canned and used as pie fruit, made into jam, or used for the preparation of fruit syrups.

Packing Fruit into Cans.—Cans coated with acid-resisting

lacquer should be used for coloured fruits, otherwise bleaching of the fruit takes place. The fruit should be packed into clean scalded cans, to within one-eighth inch of the top, and a definite weight should be put into each can. Whole fruit should be packed as tightly as possible, and bruising should be avoided. Small soft fruits should be shaken down into the cans.

Syruping and Exhausting.—Although fruit may be preserved satisfactorily in water, it will be found that by using a sugar solution as a covering liquid, much better results will be obtained. A heavy syrup helps to retain the fresh fruit flavour, and also tends to maintain the colour of the product. From 4 lb. to 10 lb. of sugar per gal. of water should be used, the amount depending on the variety and sweetness of the fruit. The syrup should, if possible, be made with soft water, and filtered clear through muslin before use. In home-canning, the syrup must always be used *boiling*, and sufficient poured into each can to cover the fruit. The steam rising from the syrup drives the air from the can, and it is essential that the contents of the can should not be allowed to cool before the can is sealed. If air is left in the cans, it may cause slight discoloration of the fruit at the top of the can, and may also cause "pin-holing" or corrosion of the tinplate. For this reason, therefore, the temperature of the syrup should not fall appreciably before the can is sealed, and it is advisable not to fill more than six cans at a time before sealing.

Sealing the Cans.—The process of fastening the lid is termed "double seaming," and is as follows (*see* Fig. 4) :—

The cam lever (*a*) is adjusted so that the bottom plate (*b*) is in its lowest position. The filled can, with loose end fitted in position, is placed on the bottom plate (*b*), which is then raised by turning the cam lever (*a*) to the fullest extent, when it will be found to lock. In this position the chuck (*c*) fits into the recess in the cover, and clamps it firmly into position on the can. With very little practice, it will be found that the can can be placed accurately in position and locked quickly. The can, having been locked in position, is revolved by turning the handle (*d*) of the machine with the right hand in a clockwise direction. Simultaneously with the left hand the operating lever (*e*) is pushed away from the operator until the first operation roller presses against the edge of the cover. Pressure should then be applied steadily and firmly, but *not too quickly*, and should be continued until the roller stop comes up against the machine stop (*f*), when the first operation

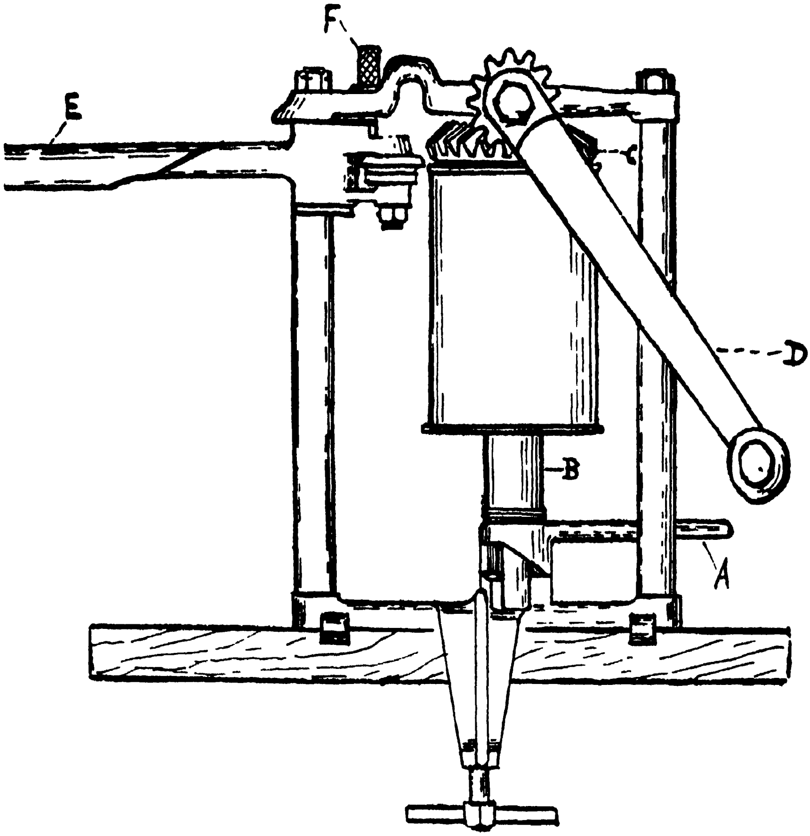
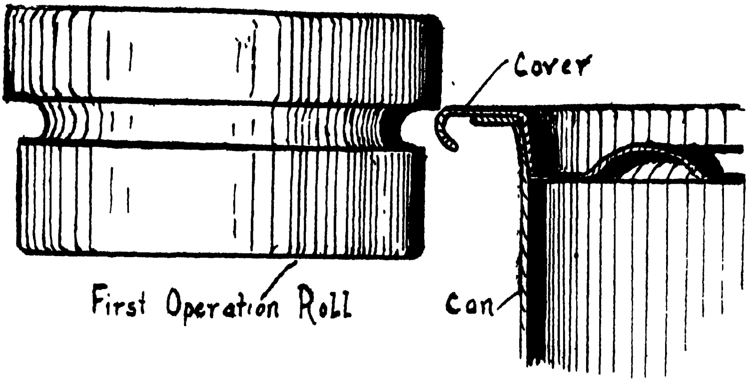
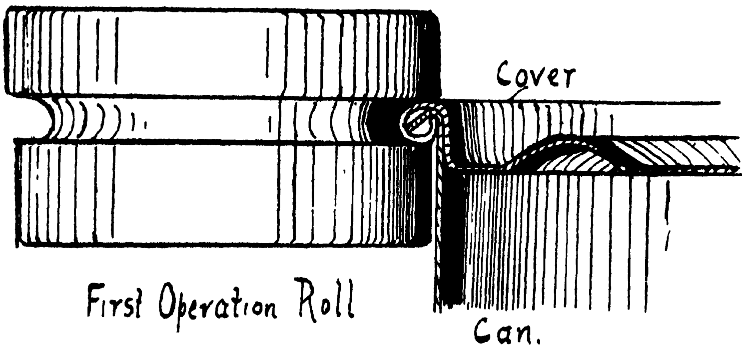


FIG. 4.—Diagram of Hand Power Can-Sealing Machine, with Can in position for Sealing.





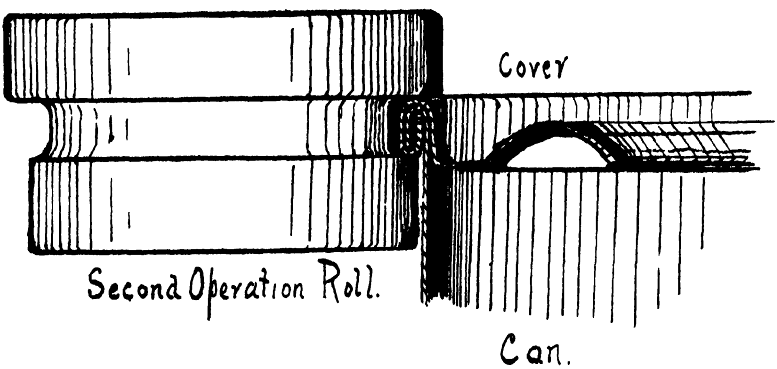


FIG. 5.—*Top*, Position of 1st operation roller.
„ 6.—*Centre*, Can and Lid after the 1st operation.
„ 7.—*Bottom*, Completion of Sealing the Can.

is complete. If the operation has been performed to perfection, a steady application of pressure should bring the stops together in about twenty-four revolutions of the handle. The operating lever (*e*) is then pulled towards the operator, until the second operation roller is brought into contact with the edge of the can. Pressure is again applied whilst the handle (*d*) is turned until the second roller stop comes up against the machine stop (*f*), when the seaming is completed. A steady pressure is desirable in the second operation, but it is not so necessary as in the first, since the first operation forms the seam, and the second merely flattens and presses it. As it is most important that the seam should be evenly formed and tightened all round, the can should in both operations be revolved several times after the roller stop appears to have come up against the machine stop. The actual seaming is carried out by two small rollers, as shown in Figs. 5, 6, and 7.

In Fig. 5, the first operation roller will be seen adjacent to the can.

Fig. 6 shows the cans and lid after the first operation has been completed, and before the roller has been withdrawn. It will be noticed that the edge of the lid has been rolled round and under the edge of the can. In order to secure a good result the first operation roller must be brought in very slowly.

In Fig. 7, the second roller has completed its work, but has not yet been withdrawn. It is of great importance that the first operation roller should complete its work before the second roller is brought into play, otherwise a faulty seal will result.

Sterilising.—Immediately the cans are filled, they should be sealed. When a batch has been completed, they should be placed in a vessel of boiling water, and the water, which in consequence is slightly lowered in temperature, again brought to the boil. The cans should be boiled for fifteen to sixty minutes according to the kind of fruit and the size of the container. The amount of heat which is conducted to the centre of the can is sufficient to destroy the enzymes and the micro-organisms, which would otherwise cause the fruit to go bad. In the writer's experiments the times found necessary to effect sterilisation in boiling water are given in the table at the end of this article.

Cooling.—When the cans are removed, they should be placed at once in cold running water, so that the fruit may not be over-cooked. To obtain a good quality product, quick

cooling is essential. After cooling, the cans should be thoroughly dried and placed in a dry store to avoid rusting.

Faulty Cans.—If the contents of a can go bad, it means that either the sterilisation was not sufficient or, what is more likely, that there was a leak in the container through which the organisms gained access to the fruit subsequent to sterilisation. Using inferior or fallen fruit may introduce organisms which are not destroyed at the usual sterilisation temperatures, and for this reason the use of clean, sound fruit is essential. A leak is easily detected when the cans are placed in the hot water bath, as a small stream of bubbles will rise from it when the contents become hot. Any "leaker" thus detected should be removed and the fruit repacked in a fresh container. In this case the syrup from the leaking can must be boiled again. The proportion of faulty seals should, however, be very small if the sealer is properly adjusted and the cans are of good quality.

Selection and Preparation of Fruit.—*Gooseberries.*—This fruit is best picked under-ripe, but the berries must not be too immature or they will have little flavour. For preserving purposes green varieties of medium size are preferable. Gooseberries which are to be canned, must first of all be well washed and the stalks and blossom ends removed. This is generally referred to as "topping and tailing" or "snibbing." When the berries are snibbed by hand, it is advisable to remove a portion of the outer skin at each end, otherwise the fruit will shrivel when canned in a moderately-heavy sugar solution.

Raspberries, Loganberries, and Blackberries.—There are many varieties of raspberries: of those tested the following have given good results:—Lloyd George; Calstock Seedling; Baumforth's No. 2; Semper Fidelis; Fastolf (Burnham); Blackshaw Station; Bourton Coombe; and Bunyard's Profusion. Fairly good results have also been obtained with Baumforth's No. 1; Devon; Worcester Prolific; and Pyne's Fillbasket.

Raspberries are very easily bruised, and careful picking is essential. The fruit should be gathered while it is firm, and it is better to put it into shallow baskets so that the berries at the bottom will not be crushed by the weight of the fruit above them. Both raspberries and loganberries deteriorate very quickly; to obtain the best results, therefore, the fruit should always be preserved on the day on which it is picked.

For canning, the fruit should be picked over and only the

firm, sound berries selected. The ripe fruit should be used for jam-making or for the production of fruit syrup. Raspberries should first of all be hulled very carefully and washed if necessary. Loganberries are liable to contain maggots, and for this reason it is advisable to soak them in a dilute salt solution (½-oz. salt to one quart of water) for two hours. This brings out the maggots from the fruit. The berries should then be rinsed in cold water, and packed without removing the hulls. Unless firm, slightly unripe fruit is used, a soft pulpy mash will result.

Blackberries may be utilised profitably if preserved, and the colour and flavour are well retained when canned. The fruit should be gathered while it is still firm and ripe. Late in the season blackberries are poor in flavour and give only indifferent results. The hulls should be removed and the fruit carefully washed before it is packed into cans.

Strawberries.—Only a few varieties have so far been tested Satisfactory results have been obtained with Paxton's. The berries should be of uniform, medium size, free from blemishes and not too ripe. The best results are obtained when a heavy syrup is used as a covering liquid.

Strawberries when canned in the same way as other fruits are not attractive in appearance, as the berries lose their bright red colour. The commercial canned strawberries are dyed with artificial colours, but the use of dyes for this purpose in the home is not recommended.

Cherries.—Many English varieties of cherries are excellent for canning. They should be a good size, fleshy and full of flavour. For this reason, black cherries are better than white varieties. Suitable black varieties are : Blackheart, Oxheart, Knights, Waterloo, and Rivers. White cherries when bottled or canned lack flavour, and the pink flush which is characteristic of some varieties disappears entirely when the fruit has been sterilised. They are, however, very suitable for mixing in fruit salads. If canned for this purpose, the fruit should be as free as possible from blemishes, as these become more pronounced when the fruit has been sterilised. Amber, Bigarreau, and Whiteheart are good varieties for use in fruit salads. The heart-shaped Elton is not so suitable for this purpose. Among red and more acid varieties suitable for canning are Morellos and May Duke. Morello cherries have proved very satisfactory for their preserving qualities, but May Duke is an even better variety, as it possesses a rich and spicy flavour and is of a bright colour. Red cherries in

syrup are in demand in the confectionery trade and are often used in commercially-packed fruit salads. These are artificially coloured, a fast dye being used so as to avoid staining the other fruits in the pack.

Currants.—Black, red and white currants may be canned in the same way as other fruit. Fully ripe juicy fruit of a good size should be used; where inferior fruit only is available, it is better to use it for jam or jelly making. If put up in well-lacquered cans, currants are excellent in flavour and retain their colour. The fruit should be prepared by removing the stalks and, if necessary, washing gently.

Blackcurrants are particularly suitable for canning.

Plums and Damsons.—There are many varieties of plums which give excellent results when canned. The common yellow egg plum or Pershore plum is frequently superior to the less common varieties. Victoria, Pond's Seedling, Cox's Emperor, Golden Drop, and Magnum Bonum, all give good results. Among the purple varieties, Purple Prolific, Jimmy Moore, Purple Pershore, Czar, and Coe's Late Red have all been found suitable. Monarch and similar plums are not so suitable for canning, as after some months they lose their attractive colour.

When there is a heavy crop of plums it will be found advisable to commence canning whilst the fruit is still green. Plums are generally packed whole, but a good pack for home use may be made by halving the fruit and removing the stone. In this case the fruit should be firm and ripe, and fleshy varieties, such as Victoria, Pond's Seedling, and Magnum Bonum will be found very suitable. The cut surface of the fruit becomes brown when exposed to the air, and it is customary to prevent this by placing the halves in a vessel of salt water (approximately 2 oz. salt per gal. of water). The fruit should be kept completely submerged in the brine.

When this method of packing is adopted fewer cans per unit weight of fruit will be required. At the same time, when turned out, the amount of fruit to syrup is rather large.

Pears.—Owing to the vagaries of the English climate it is doubtful if entirely satisfactory canned pears can be produced. Several of the English varieties give fair results, but the best canned pears are obtained when only well-ripened dessert fruit is used. At the same time, many of the coarse varieties, and those which do not ripen fully, may be made very palatable, although the appearance and texture are not so good as those of dessert varieties.

The following varieties have given good results :—Hessle, Williams, Louise Bonne de Jersey, Beurré Hardy, Duchess d'Angoulême, Marie Louise, Fertility, Conference, Strawberry, Catillac, Josephine de Malines, and Pitmaston Duchess.

Pears when peeled become discoloured if exposed to air for even a short time. This is due to the action of oxidising enzymes, and may be prevented by placing the fruit in a weak brine, made by dissolving 1½ oz. of salt in one gal. of water. The pears should be washed, peeled, cut into halves, and cored. The halves should be placed immediately in the brine, and a plate laid on the top of the pieces to prevent their rising to the surface and becoming exposed to the air. After filling into the cans, the pears should be washed in cold water to remove traces of salt.

Dessert Varieties.—Pears lose their delicate flavour when canned in water. The best results are obtained by using sugar solution as a covering liquid ; this is made by dissolving 6 lb. of sugar in each gal. of water.

Cooking Varieties.—The fruit should be gently stewed until quite tender, in a syrup prepared by dissolving 2 lb. of sugar in one gal. of water. The pears should then be drained, and packed into cans. The syrup should be boiled until it is reduced to half the volume originally made up, and then poured hot over the fruit. Shrinkage takes place when the fruit is cooked, and therefore the cans should contain only two-thirds fruit in order to secure a suitable proportion of fruit to syrup when the contents are turned out.

Apples.—The best apples for canning are the cooking varieties which are fairly acid. Canned apples are chiefly used for pies, and it is therefore advisable to pack the fruit into cans with as little water as possible.

The fruit should be peeled, cored, quartered, and cut longitudinally into slices. As apples quickly brown when exposed to air, they should be placed in brine, the same as for pears. The slices should then be washed in cold water and steamed for about five minutes, or until they are just soft enough to be packed tightly into cans. The cans should be filled with boiling water and sealed at once. If the pack has been satisfactorily made, the apples should retain the shape of the can when turned out.

Tomatoes.—The tomatoes should be washed, blanched, cold dipped and peeled. They should then be gently simmered for ten to fifteen minutes, but no liquid should be added.

The tomatoes are then packed into the cans together with the juice which has come from the fruit. Both the fruit and juice must be boiling, and the can filled to within about $\frac{1}{8}$ in. from the top. Each can should be sealed immediately it has been filled.

TIME TABLE FOR PROCESSING FRUITS IN Nos. 1, 2, and 3 CANS, AND STRENGTH OF SYRUP TO USE

Fruit	Strength of syrup in lb. of sugar per gal. of water	Process in Boiling Water Nos. 1 and 2	No. 3
	lb.	Minutes	Minutes
Gooseberries ..	4	20	45
Raspberries, Loganberries and Blackberries	6	20	45
Cherries .. .	4–6 (according to acidity)	30	55
Strawberries	10	20	45
Currants . ..	6	20	45
Plums and Damsons	4–6	20	45
Plums in halves ..	8	35	60
Pears	4–6	25	55
Apples ..	None	25	55
Tomatoes .. .	None	30	60

ROOT AND FODDER CROPS

(A conference on the cultivation and manuring of fodder crops was held at the Rothamsted Experimental Station on March 30 last. The following short article forms a résumé of the proceedings. In the absence of Lord Clinton, the Chair was taken by the Rt. Hon. Lord Bledisloe, Parliamentary Secretary to the Ministry.)

IN opening the Conference Lord Bledisloe said that it was the last of a series of three held at Rothamsted during the winter, the two previous ones having been on the manuring of potatoes and the cultivation of lucerne.

Lord Bledisloe referred to the rejuvenation of agriculture in the eighteenth century by the work of " Turnip " Townsend and Coke. The establishment of the four course rotation and the introduction of improved fodder crops enabled animals to be better carried through the winter, and the potentialities of animal food production had consequently been enormously developed. At present the backbone of agriculture was the

livestock industry rather than corn growing. The wise utilisation of fodder crops enabled the shrewd farmer to make a living where he might otherwise fail. He was not disposed to agree that mangolds were a crop of the past.

Rothamsted Experiments on Root Crops.—Sir John Russell discussed the results of the Rothamsted experiments on root crops, remarking that fodder crops were of importance in several ways. Livestock depended on them, and there must always be sufficient grown to see the livestock through the year. The farmer had to insure against a bad season, and consequently often produced an excess of fodder crops in a good season, these crops varying much more with season than do cereals. This he demonstrated by the following table showing the yield of swedes at Rothamsted in good and bad years:—

Yield of Swedes in tons per acre	Poor years		Good years	
	1913	1920	1922	1924
No artificials	3·2	3·3	25·2	17·3
Sulphate of ammonia and potash ..	6·4	9 3	28·1	19·1
Sulphate of ammonia, potash, plus phosphate	8 6	16 3	29·0	20·6

The usual yield of swedes in the south was 12 to 15 tons per acre, but was much higher in the north where up to 50 tons per acre had been recorded.

Fodder crops would not stand starvation conditions, in this respect differing somewhat from wheat; a single full head of wheat on a poor soil was almost indistinguishable from that grown on well-manured land, though starvation reduced the number of full heads per plant. With the fodder plant the result was very different, possibly because it represented only an intermediate stage in the production of seed, since the seed of a poor fodder crop would be indistinguishable from seed produced on good land.

Swedes and turnips might quite properly be grown without dung, and for them there was no point in using both farmyard manure and artificials, at any rate in the south. It was exceptional to find a crop benefiting from both, and it might often happen that it was best to use artificials and save the dung for other crops. Phosphates were most effective on swedes as is clearly shown in the above table; they were, however, less effective in a good growing year than in a bad season, their great advantage being that they help in a year when the crop is liable to suffer, and should therefore be used by way of insurance of a reasonably good crop. Over a run of seasons superphosphate had proved the best phosphatic manure, but

where there was a liability to finger-and-toe basic slag probably had the advantage.

Attention was now being directed to mineral phosphates; these must be finely ground, *e.g.*, to pass through a 120 mesh sieve. They had proved effective in Northumberland, and might be used if the price were favourable.

As to the effect of nitrogenous fertilisers, at Rothamsted it had been found that 1 cwt. of sulphate of ammonia produced about 1 ton per acre increase, either with or without dung, whether the season were good or bad. This was a striking property of nitrogenous manures contrasted with other fertilisers. In a good year it was probably not worth spending money on nitrogenous manure, but it was a wise precaution against a bad year. About 1½ cwt. of sulphate of ammonia was as much as could profitably be applied. Potash did not usually produce any notable increases in crop.

In the case of a second group of fodder crops—mangolds, cabbage, kale and leafy crops—it was an unsound practice not to use farmyard manure. Some Surrey farmers made a practice of using very large quantities of dung and produced enormous crops. As substitutes for dung, town refuse was cheap, and waste straw to which nitrogen compounds had been added might also be used. Next to farmyard manure nitrogenous fertilisers were very effective with this group of crops and produced considerable increases. Sulphate of ammonia should be put in with the seed and nitrate of soda or nitrate of lime could be appled at the time of singling. Potash was also required for these crops. As the mangold was originally a seaside plant it might be expected to respond to salt, and in fact salt plus potassic fertilisers gave good results, so that kainit was quite a suitable form. Potash was especially necessary on dairy farms where a good deal was removed in the milk. The composition of these crops might be somewhat different according to district; *e.g.*, at Aberystwyth mangolds contained only 10 per cent. dry matter compared with 15 per cent. at Rothamsted. Kale and cabbage were leafy crops which responded well to nitrogen, and farmyard manure plus nitrogenous fertilisers could be recommended.

Swedes and Kale.—Mr. W. A. C. Carr in dealing with swedes and kale observed that farmers were told that roots were unprofitable, but yet they stuck to them. He thought the difficulty was to find substitutes. Roots produced a large amount of dry matter per acre, and they kept the land clean.

For a successful growth of swedes dry conditions early in the season were essential, with rain later on when the plants had met between the rows. Heavy wet soils seldom yielded big crops. A good ley in the rotation would do much to help the growth of roots as it got the soil into good condition, reduced the frequency of the root crop, and reduced liability to damage through club root. A six course rotation with three years' ley had been successful in Aberdeen. Ploughing should be done early, a little deeper than usual, and the furrow well set up. Farmyard manure should be ploughed in as soon as possible. Cross ploughing should not be carried out later than March, and successive cultivations should follow to secure the desired tilth. At Aberdeen the beginning of May proved the best time for sowing swedes and turnips, later sowing appearing to reduce the crop. Conditions were different in England and it was difficult to indicate when swedes should be sown. The Craibstone experiments showed the importance of early thinning particularly in the case of turnips. Experiments at Reaseheath made it clear that season had a much greater effect than manuring. As regards manuring, top dressings with nitrogen were quite effective, and on poor land the addition of soluble phosphate might be the deciding factor in the success of a crop. A small dressing of superphosphate brought the crop on early, and potash was necessary to prevent too early ripening. Lime should be applied to counteract tendency to club root. At Reaseheath marrow stem kale was more reliable than swedes. It had been found the cheapest autumn feed and had therefore replaced swedes; its cultivation was similar. It could be sown successfully from the end of March to the end of June, and could be used from August to the end of December. Thousand Headed Kale did not give so good a yield as Marrow Stem Kale, and it got in the way of succeeding crops. Kale responded well to manure, especially on poor soils, but 30 tons per acre was as much as could be used, and the crops should be top dressed after thinning. One acre marrow stem kale would provide green food for 14 to 15 cows until Christmas, after which swedes or mangolds are more useful.

Mixtures for Forage Crops.—In the course of a paper dealing with mixed forage crops, Mr. J. C. Brown observed that we were less inclined in this country than on the Continent or America to use improved methods of growing fodder crops, because we were so well able to grow good grass. The real problem, therefore, was fodder crops *versus* grass, and whether

it was a more paying proposition to grow a small amount of grass or a large amount of arable crops. In the U.S.A. both stock farming and wheat farming were based on lucerne. Dealing with individual crops Mr. Brown stated that the Flat Pea (*Lathyrus sylvestris*) and Bokhara Clover gave a large amount of fodder per acre, but rapidly became woody. Valuable fodder crop mixtures were rye and vetches ; rye and beans ; rye and peas ; oats and peas ; peas and wheat ; chicory and alsike ; wheat and vetches ; beans, peas and wheat ; beans, peas, barley, oats ; and carrots and parsnips. The best hay mixture was probably two bushels of peas and one bushel of oats. Any variety of pea might be used. Dunn's oat was very hardy, and much better for making into hay than other varieties. The best time for sowing this hay mixture was from the middle of February to the end of March, and the best time to cut it was when the pods were beginning to form, and the oats were in the milk stage.

Making hay crops was not such a good policy as allowing the crops to go to seed, but in producing seed crops plans had to be altered so as to include a succulent fodder for feeding, and the mixture had to be strengthened with beans to prevent it going down. The mixture he recommended for grain was two bushels of beans, 1½ bushels of peas, 1 bushel of barley and 1½ bushels of oats. Four bushels per acre of this mixture gave the best results. The mixture could be sown from mid-September to the beginning of May, the best time being the second half of November, the middle of January and the middle of February. For the production of seed, the mixture should be sown not later than March. Farmyard manure was useful on poor land, but on average land it was not necessary to give more than a dressing of 5 to 8 cwt. per acre of basic slag. Nitrogen was generally less effective than other manures. The crop could be harvested with the ordinary binder, peas and beans ripened out well in the stook and their straw made useful fodder when cut early. This mixture, he stated, could be grown for several years on the same land with increasing yields. It improved the condition of the land by keeping down weeds, opening up and pulverising the soil, and adding nitrogen. He found the cost of growing was £6 to £9 per acre, and the yield on the average 25 cwt. of grain and 35 cwt. of straw. Even allowing no value to the straw the cost per ton was therefore lower than had to be paid for purchased feeding stuffs. The cost per pound of starch equivalent of the whole crop worked out at 0·8 pence approximately.

Mangolds and Sugar Beet.—The cultivation of mangolds and sugar beet was dealt with by Mr. C. Heigham who pointed out that mangolds were still a forage crop of first rate importance, although the acreage had fallen considerably in the last fifteen years, and the decline might be greater in future owing to the increasing popularity of sugar beet, kale and silage, and because it had been found that some dairy herds could be managed without roots. Mr. Heigham confined his remarks to the critical stage in the growth of the crop, namely, the very early stage. The life of the crop was very precarious until after the effect of singling had been overcome. He recommended deep cultivation, although he admitted there was little experimental evidence. Seeds should not be sown too deeply, the seed bed being firm but not too moist, and the deep work should be finished by mid-February. It was often difficult to get so well forward. There was much to be said for growing mangolds on the ridge as they could be hoed better. Early singling was of great importance as was also regular subsequent hoeing. The critical stage was passed once the work of singling was over, but after this repeated hoeing and top dressings might affect the yield very much.

Referring to sugar beet, Mr. Heigham remarked that the two most important considerations were the price and the sugar content, these influencing the policy regarding cultivations. Sub-soiling was profitable and should be carried out, since it favoured quick growth of the long tapering root below the soil. An application of up to 15 tons per acre of farmyard manure should be given. Enough plants could be produced by 7 to 8 lb. of seed, but it was wiser to use from 15 to 20 lb. It was important to obtain a close even plant, and for this reason Continental growers placed rows close together. As regards space between the rows, he felt that it should be a compromise between the 14 in. in Holland and Germany and the 26 in. in this country. Rows 18 to 20 in. apart with the roots 10 in. apart in the row would allow horse hoeing and might produce 34,600 roots to the acre or a crop of 12 to 13 tons.

There was no reliable evidence as regards the relative merits of growing on the flat and on the ridge, but he thought that the former was better to get the maximum of sugar content. Rolling after sowing was generally practised and was to be encouraged, as thorough compression of the soil was essential. Early singling was of great inportance. German figures showed the great difference in yield between

singling at the proper time and from one to three weeks later. It should be carried out as soon as the plant had four leaves, and should be done by hand. Hoeing should be continued until the leaves met in the row. As much as 3 cwt. per acre of sulphate of ammonia or nitrate of soda was recommended, as any danger of the reduction in the sugar percentage was more than counterbalanced by the increase per acre of sugar. It was not certain that the sugar beet plant was equally responsive to heavy potash dressings.

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EIGHTEENTH CENTURY FARMING

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It has become a commonplace of agricultural history that the early part of the eighteenth century was a period when the whole of the farming community found life agreeable and their necessities plenteously supplied. All the pictures of romance and happiness in which this halcyon time is portrayed have their antitheses in the picture of the latter part of the century drawn by the same writers. In these hands the contrast is made to appear little less than a descent from heaven to hell. The modern historical investigator, of whose work fair specimens are before us,* does not usually allow himself the privilege of believing that such extraordinary contrasts in the conditions of human life can be discovered in the story of any century, unless it embodies some cataclysm either natural or social.

Mr. Gaunt (1), however, does believe in this sharp break in historical development. He says of the earlier period: "The standard of prosperity was fairly even, the representative men of the countryside were those of moderate substance . . . the yeoman, the farmer, and the labourer with his cottage and four acres of ground formed gentle degrees of status, and the Squire himself was not always above taking his pleasure in the village alehouse amongst mixed company." The elementary error in this statement is the assumption that every cottager possessed the four acres of land which the Elizabethans had deemed necessary for his well-being, but of course such a holding was not common—it was the exception rather than the rule. The plenty he describes was confined to a small section of landowners and large tenant farmers. Mr. Gaunt admits that for the labourer "ostensibly his main articles of diet were wheat or rye bread, cheese and beer." This simple

* See Reference at end of article.

and monotonous fare does not seem to be evidence of any great and general material prosperity, although Mr. Gaunt adds that "it has to be remembered that meat was only 2½d. per lb., and that a little judicious poaching would always supply him with an addition to his table. His loom and his own poor crust were reliable resources, and if the work was hard it was carried out under pleasant conditions." Meat may have been only 2½d. a lb., but extant budgets of farm labourers for this century do not disclose any very large consumption of meat; the average labourer earned so little that he was lucky if he got a joint on Sunday.

The large numbers of the indigent poor were a subject of concern to the governing class during the seventeenth century. In the eighteenth the problem became very much more serious. The interesting picture of the life of the Squire drawn by Mr. Gaunt does not bear any relation to the life of the great majority of the rustic community. Dr. Moffit (3) has set out the kinds of food used in Lancashire, and has shown that Mr. Gaunt's estimate is not so very far out. From 1700 to 1800 the only real change which took place was the substitution of tea for beer. As Mr. Witt Bowden (4) says, "The idyllic pictures of the state of labour preceding the rise of modern industrialism painted by its opponents must be largely discounted."

The Distribution of the Land.—Quite recently the last remaining open-field village in England was offered for sale, and has attracted some public attention. There is in consequence a more general realisation of the part the open field played in the economic life of our forefathers. The open field system was certainly very much more widespread in the early part of the eighteenth century than it was at the end, but even in the nineteenth there remained a large number of villages which had to be enclosed. The change from common to severalty, although accelerated in the last half of the eighteenth century, had in fact been gradually made, as opportunity arose and necessity directed, for at least 500 years. It was not only the force of the Inclosure Movement which affected the position of the yeoman and domestic worker in the rural community, it was the driving force of the economic influences which could not be overcome or controlled by any class. It is often assumed that there were no landless men prior to the Inclosure Movement of the eighteenth century: Mr. Gaunt specifically says that the cottager always possessed four acres. But in 1696 John Bellers was concerned with making provision for the indigent poor, and his estimate of their

numbers was one million. As the population was only about five or six million at that time there was a very large proportion of landless men before the eighteenth century opened.

The general economy of farming in a country is dependent upon the size of the farms in that country. From the early part of the seventeenth century there had been a tendency to increase the size of farms for the purpose of working them more economically and attracting tenants of more substantial capital. One result of this tendency was that almost all the pamphleteers complained bitterly of engrossing and depopulation, but their complaints were doubtless dictated by their limited observation of local circumstances.

Before the acceleration of the inclosures great farms were not unknown, and Dr. Moffit supplies contemporary evidence of their existence. In 1752 Suffolk had large farms, and in 1755 some as large as 3,000 acres were to be found in Norfolk. "But it would be a mistake to suppose that the whole kingdom was monopolised by large farms," he goes on, and proceeds to an analysis of Arthur Young's figures, which show that of 250 farms the average size was 297 acres, 148 grass and 149 arable. This is an average acreage much the same as the modern farm: it is indeed rather larger. The small-holdings, where they could be found, as in certain districts of Lancashire, for which Dr. Moffit has adduced new evidence relating to the occupiers and size of farms, were usually occupied by weavers and cloth workers who used their holding as a subsidiary occupation. Of one group of 292 occupiers, 222 have not more than 15 acres each, and many much less. Under the conditions of the domestic industry system, holdings of this size played much the same part as allotments in the lives of modern industrial workers. They could hardly be described as farms, and the comparatively large average acreage of the farms tabulated by Young precludes the idea of a race of small-holders.

Farming Processes and Rotations.—Dr. Moffit has gone very closely into the contemporary literature dealing with the methods of culture adopted during the century. He sets out the common rotation of the three-field system, *i.e.*, winter wheat, spring corn (barley or oats), and fallow, and he indicates the changes that were taking place wherever possible and where the farmers realised the benefits to be expected from the adoption of different rotations, and from the use of the newly-introduced artificial grasses and root crops.

The beginning of the century saw the introduction on a wide scale of the artificial grasses. Previously, as Dr. Moffit

points out, the method of laying down a field to grass "was the simple but uneconomical one of ceasing tillage," but a writer in 1700 (Tim Nourse) shows that the "foreign grasses were gaining in popularity," and "by the sixties their cultivation had become fairly general." Naturally they became part of the improved rotations which are increasingly discussed by the contemporary writers on farming as the century progresses.

The turnip, which had been advocated by numerous "book farmers" since Weston visited Flanders in the early seventeenth century and saw it cultivated there, did not become so popular in the north of England as the grasses. It made more progress in the south. Carrots and parsnips were also recommended as cattle food, and potatoes became the subject of more discussion, although they were only cultivated on an extensive scale in Lancashire by the end of the century. They were popular in other parts of the country and were constantly recommended as food for the poor, but it was in the Ormskirk district that they became most prominent in actual practice.

The passion for improvement was no less marked in agriculture than in industry during the whole of the century, and it is possible to discover rotations set out for eight, ten and even twelve successive years. In 1775, a "landowner" sets out two eight-course rotations for heavy and medium land, and a ten-course rotation for the improvement and reclamation of "coarse rough land." Young, in his "Tours," sets out the rotations he observed, and they vary between the simple rotation of the three-field system and the numerous courses of the different "improved" rotations which include all the new crops. Naturally enough, at the beginning of the century these improvements were far less widespread than they were at the end, and it is to the influence of such people as Coke of Norfolk that many of them can be traced. It is, however, a little exaggerated to say, as Mrs. Stirling (2) does, that the agriculture of the county of Norfolk was of the poorest description before Coke settled down to farming there. All the evidence goes to prove that the agriculture of Norfolk was in quite a different position in relation to the agriculture in the other parts of the country. Dr. Moffit's opinion, which is based on a meticulous examination of the agricultural writings of the time, is diametrically opposite. In connection with his remarks upon the root crops, he says that "Norfolk was generally regarded as the most advanced county in England

agriculturally." Nevertheless, Coke did improve his own estate from a rental of £2,000 to £20,000 a year, and that is a sufficient indication of the quality of his work. At the same time a number of other landlords were occupied in similar improvements, and a number of prosperous tenant farmers were doing their best to improve the yield of crops and to improve the breed of cattle. Coke was one of the class of men to which British agriculture owed a great deal, and a summary of his system which Mrs. Stirling cites (it is that of Lord Spencer) may be taken to be that of what we may call the improving class of agriculturists :—

Improved rotations of crops.
The application of marl and clay.
The judicious use of artificial organic manures.
The adoption of a more profitable description of live stock.
Exciting the general use of the drill.
Creating good feeling between lord and tenant.
Granting liberal leases.

The Improvement of Cattle.—It is interesting to note that Coke imported a number of Merino sheep for breeding. The experiment failed and he abandoned the flock ; but this is an example of the type of experiment which was so extensively carried out at that time, and which resulted in so great an improvement in the meat-producing quality of cattle and sheep, that at the end of the eighteenth century it was commonly stated that the average weight of carcasses had increased one-fourth during the hundred years.

In addition to his experiments with Merino sheep, Coke introduced Shorthorn cattle to his farms, but after a time he abandoned them and substituted the Devon breed. This he did because, after a fattening experiment, he found the weight of the beasts killed was 110 stones for the Shorthorns as against 140 for the Devon, even though the latter had been given less food. Coke, of course, was not the classical breeder. Bakewell is the man to whom modern times owe most. His primary interest was the development of sheep, but he did not neglect cattle, and his work, as Dr. Moffit says, was the more successful in that it attracted a host of imitators to whose combined efforts the general improvement of cattle and sheep during the century must be attributed.

Increase in Acreage Yield of Wheat.—Something similar to the increased dead weight of animals can be said about the average yield of corn per acre. An increase of at least two or

three bushels per acre over the quantity usual in 1700 was everywhere apparent at the end of the century.

Although this increase was by no means due only to the introduction of the new horse-hoeing husbandry of Tull, there is no doubt that the century-long controversy aroused very great interest and stimulated many experiments in manuring and cultivation generally. The drill, which Tull designed and used, was not altogether a new idea, but its ability to work was new. Late in the seventeenth century Worlidge illustrated and wrote of a drill, but a farmer who tried to make one according to his instructions found it would not work. Nearly a hundred years before that time, Maxey's setting board was described and illustrated, but it involved a tedious and laborious manual process, and was scarcely adapted for drilling corn. Tull's invention overcame the mechanical difficulties involved, and his horse hoes, which enabled him to do without manure while continuously cropping heavy harvests of wheat, directed the attention of the farming community more urgently than ever to the question of manures and their effect upon the soil and the crop.

In all the writings of the time the question of the value of the various materials used for manures—and they were numerous as well as singular—is argued voluminously. The mainstay was, of course, farmyard manure, but the practices of marling and liming were strongly advocated. Again, the mixing of soils to alter their consistency was commonly written of as a useful and beneficial method to adopt. For instance, sand was recommended for mixing with clay soil, and vice versa. Ash, town refuse, ox-blood and hair, rags, old leather and many other things were all tried and some gave excellent results.

Another practice around the utility of which controversy raged throughout the century was paring and burning. It was used before planting roots to be followed by corn, and it was condemned on the one hand as affording a heavy yield at the expense of the future productivity of the soil, and praised on the other as an excellent method of reclaiming waste rough land. It had begun to die out towards the end of the century, and was finally abandoned in the nineteenth.

Implement Design Improvement.—Throughout the reports of the Old Board of Agriculture and the writings of Arthur Young are scattered criticisms of ploughs and ploughing. The old plough was a heavy implement made of wood and drawn by four, six or more draught animals. It was, however, not

universal at the beginning of the century, and it can be shown that different ploughs were in existence at a very early date in our history, but the eighteenth century marks the birth of the modern types. The trend of design evolved towards the modern plough during that century.

The light Norfolk plough, the Rotherham plough and many others found their popularity spreading through the country because they tilled the soil more efficiently and were of lighter draught. The work of the Royal Society of Arts should be mentioned. The Society offered many premiums and prizes, and the numerous and varied implements shown in Bailey's "Advancement of Arts" (1770) shows how the spirit of invention, characteristic of the time, had brought into being numerous new types of implement. Amongst others illustrated in Bailey's book, the earliest iron plough is shown.

The development of the harrow and the weird designs of roller which are mentioned show another manner in which efforts were being made to increase the farmers' ability to secure a good tilth.

The population had probably only doubled during the eighteenth century. At the same time this population was centred in a number of growing industrial towns, and although practically the same number of people were engaged in agriculture in the year 1800 as it employed in 1700, the output of the earlier time could not have provided for the requirements of the increase in population. If the improved methods, which enabled the soil to yield a greater output, had not been adopted, the country would have been forced to import even more largely than it did in the later years of the century in order to supply the necessities of its people.

It is, however, incorrect to say, like Mrs. Stirling, that "before Coke had transformed the aspect of agriculture throughout the country, England, unable to feed her people, was dependent for sustenance on foreign supplies." During the greater part of the century England was a large exporter of food-stuffs, and it was not until the last years that the increase of her population and other forces changed her from a food-exporting to a food-importing country. It is true, as Mr. Witt Bowden says, that the landed classes, in whose hands the government of the country was so largely held, desired a "general policy of encouraging agriculture in preference to manufacturing," but the growth of an industrial population of large dimensions made it necessary to resort to a freer system of corn importation. The output of foodstuffs at the

end of the century was larger than it was at the beginning but it had not increased in the same proportion as the population, and changes in the direction of the application of labour had made it necessary to abandon the idea of maintaining the country on a self-sufficient basis so far as food stuffs were concerned. Every effort was made to thwart this trend of development, but for good or for evil the die had been cast, and the end of the eighteenth century saw agriculture declining from its position of foremost industry in our national economy.

(1) *Rural Life in the Eighteenth Century* W. Gaunt. (*Connoisseur*, 15s. net.)
(2) *Coke of Norfolk and his Friends* A. M. W. Stirling. (John Lane, 12s.6d. net.)
(3) *England on the Eve of Industrial Revolution* : L. W. Moffit. (P. S. King & Son, 12s. 6d. net.)
(4) *Industrial Society in England towards the End of the Eighteenth Century* : Witt Bowden. (Macmillans, 15s. net.)

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COUNTY EGG LAYING TRIALS

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IN October, 1920, the first County Egg Laying Trials were held—in Wiltshire—and since then a gradually increasing number of other counties have started them as part of their work in connection with Agricultural Education. In so doing they have received the support of the Ministry, and grants have been given towards the capital outlay on the equipment of the plant. Except for a grant from the Ministry towards the salary of a manager, the county authorities have been responsible for the maintenance expenses of the trials, but these have usually been met by entrance fees and income from the sale of eggs.

The educational value of these county trials is recognised by all who are interested in the development of the poultry industry in this country. The mere existence of the trials in a county focuses local attention on the economic value of poultry, and provides a valuable object lesson on such matters as breeding and management. They have also proved of great assistance and benefit to county Poultry Instructors in their work, the instructors being brought into closer touch with the breeders in their area. Organised parties are arranged to visit the trials, and the instructor is thus enabled to call attention to the good and bad points of the various breeds, which are further exemplified by the scoring results recorded at the trials. During lectures reference can be made to the results obtained; practical points in regard to management,

breeding, feeding, environment and other matters can easily be brought home to the audience; and any concrete facts or figures that may be quoted will have a special significance, coming as they do from an official test held under county auspices. There is no doubt that a stimulus is thus given to better methods of poultry management in the area.

Another point is that these trials serve a useful purpose in calling attention to breeders who possess good stock, and in order to encourage good breeding by competitors a clause has been inserted in the Rules in some counties requiring that the pullets entered must have been bred by the competitor. This has been done because competitors have sometimes entered pullets purchased from some other breeder. Such a practice is open to objection, obviously, because the birds entered give no indication of the competitor's skill as a breeder of utility poultry, and it is extremely unlikely that stock of equal merit will be obtained by purchasers from the competitor's farm.

Examination of the results of laying trials shows that those competitors who possess real skill in breeding are able to maintain, year after year, a position amongst the first few in order of merit.

County trials are not intended to compete against the larger open trials which attract entries from all over the county. On the contrary they serve as a stepping stone for many small breeders and beginners who would naturally be diffident about entering in trials open to all the big breeders, but who have sufficient confidence to enter a pen of birds in a county test. After having gained experience and acquired skill in this way, an ambitious breeder is soon tempted to compete in the open trials.

When county trials were first started, each county had its own rules and regulations, but efforts are now being made to secure uniformity as far as possible. A sub-committee of the Ministry's Poultry Advisory Committee has recently been appointed especially to advise on the running of these trials.

The first serious step towards obtaining uniform rules, etc., was taken in 1924, when the Ministry's Poultry Advisory Committee, after carefully considering the various rules then in use, recommended a new method of scoring and some model regulations for adoption at county trials. These were brought to the notice of the county authorities concerned, who adopted the suggestions, and the new method of scoring was used for the first time by those counties which were holding

official trials during the season 1924-25. Under this method of scoring, points are awarded for eggs laid, the number of points allowed varying with the different seasons of the year and the grade or size of egg laid. The basis of the points is money value, and to arrive at this an average was taken of the prices over a period of 10 years (7 years pre-war and 3 years post-war, omitting the actual war period and the years immediately following), the prices being taken from the Ministry's Agricultural Market Report. The scale of points laid down was designed to encourage the large egg, and for this purpose a special grade in addition to first and second grades was included. In order to qualify for this special grade a pullet must start by laying 2 oz. eggs in the first monthly period, the weight required being increased by $\frac{1}{16}$ oz. each month until the third month, when the standard for this special grade becomes $2\frac{1}{8}$ oz., at which figure it remains for the remaining months of the trials.

The primary object of these trials is to demonstrate the value of selected birds as potential breeding stock for egg production. For this purpose it is essential to encourage size of egg, and in order to maintain a good average size of eggs in a flock it is necessary to breed from birds which lay eggs somewhat larger than the average, so as to combat the strong tendency for size of egg to deteriorate.

The method of scoring in use now is as follows :—

Lunar Month	Period	Scoring Points for each egg: Special Grade	First Grade	Second Grade
First four weeks	17 days in Oct.	11	10	8
	11 ,, Nov.			
Second ,,	19 ,, Nov.	13	12	10
	9 ,, Dec.			
Third ,,	22 ,, Dec.	11	10	8
	6 ,, Jan.			
Fourth ,,	25 ,, Jan.	9	8	6
	3 ,, Feb.			
Fifth ,,	25 ,, Feb.	8	7	5
	3 ,, Mar			
Sixth ,,	28 ,, Mar.	6	5	3
Seventh ,,	28 ,, April	6	5	3
Eighth ,,	2 ,, April	6	5	3
	26 ,, May			
Ninth ,,	5 ,, May	6	5	3
	23 ,, June			
Tenth ,,	7 ,, June	7	6	4
	21 ,, July			
Eleventh ,,	10 ,, July	7	6	4
	18 ,, August			
Twelfth ,,	13 ,, August	8	7	5
	15 ,, Sept.			

DEFINITION OF GRADES

Special Grade.—Eggs of normal shape and shell weighing—
- 2 oz. and over during the first four weeks.
- $2\frac{1}{16}$ oz. and over during the second four weeks.
- $2\frac{1}{8}$ oz. and over during the third and succeeding four weeks.

First Grade.—Eggs of normal shape and shell weighing—
- $1\frac{7}{8}$ oz. and over, but under 2 oz. during first four weeks.
- $1\frac{15}{16}$ oz. and over, but under $2\frac{1}{16}$ oz during second four weeks.
- 2 oz. and over, but under $2\frac{1}{8}$ oz. during third and succeeding four weeks.

Second Grade.—All double yolked eggs and all eggs of normal shape and shell weighing—
- $1\frac{5}{8}$ oz. and over, but under $1\frac{7}{8}$ oz. during first four weeks.
- $1\frac{11}{16}$ oz. and over, but under $1\frac{15}{16}$ oz. during second four weeks.
- $1\frac{3}{4}$ oz. and over, but under 2 oz. during third and succeeding four weeks.

No limit is fixed as to the number of second grade eggs allowed to score.
No points are given for—

(1) eggs weighing less than the weights indicated above for second grade ;
(2) soft-shelled eggs ; or
(3) eggs of such abnormal shape or possessing such imperfect shells as to be obviously unfit for incubation.

A record of all such eggs is, however, included separately in the published results.

A close study of this system of scoring will show that, although due allowance has been made for the smaller egg which pullets may be expected to lay at the commencement of their laying season, any birds which continue to lay small eggs are penalised in the later months. Recent experience seems to show, however, that the small egg is not sufficiently handicapped under this scale of points, and in future county trials it is proposed to reduce the number of points awarded for second grade eggs during the 2nd, 3rd, 4th, and 5th months (which now stand at 10-8-6-5 respectively) to 9-7-5-4 respectively. It is felt that the importance of size within reasonable limits can hardly be over estimated, and there seems reason to hope that this system of scoring will do much to raise the average size of the eggs produced in this country.

Mention has already been made of the desire to obtain some degree of uniformity in county egg laying trials, and it is gratifying to note that this season (1925-26) ten of the counties which have adopted the method of scoring referred to above have in addition adopted a uniform unit of 5 pullets per entry. It has thus become possible to some extent to compare the results obtained in these ten counties. Space does not permit the reproduction in this JOURNAL of some tables which have been prepared showing the number of eggs laid and the points

scored by the leading pens in these counties, taking them as a whole, month by month, and treating heavy and light breeds separately. It may be said, however, that some very creditable results are being obtained, though hasty conclusions, by comparisons, must not be drawn from the records of the first few months only; after the trials in September next a summary of the principal results will be published in this JOURNAL.

THE "DOWNY MILDEW" OR "SPIKE-DISEASE" OF THE HOP IN 1925

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IN a previous issue of this *Journal** an account was given of a new disease of the Hop caused by the "Downy Mildew" (*Pseudoperonospora Humuli*), and the life-history of the fungus, so far as it was known then, was described, together with evidence which indicated that the disease was likely to be of serious import to the hop-grower. During 1925 fresh facts have come to light which show clearly that the injury caused by this mildew may be far more serious than was originally thought. In the following article the subject will be dealt with from the standpoint of (1) distribution of the fungus; (2) origin; (3) effect of the disease on the hop plant in its different stages of growth; (4) newly discovered facts of economic importance in the life-history of the fungus; and (5) control measures.

Distribution.—During 1925 the Downy Mildew has been observed by the writers in the following districts: *Kent*, in hop-gardens in the parishes of Wye, Boughton, Chilham. Malling, Wateringbury, East Peckham, Paddock Wood, Offham, Marden, Leeds, Yalding, Hunton, Horsmonden; on "wild" hops in hedges and waste places near hop-gardens, and elsewhere, widely distributed through the county, including districts where hops are not cultivated. *Hampshire*, in a hop-garden at Bentley. *Worcestershire*, in a hop-garden, Stanford Bridge. *Essex*, on "wild" hops, Roydon (collected by Mr. R. M. Wilson). *Devonshire*, Bickington, on a "wild" hop on which it has occurred for two years in succession.

* E. S. Salmon and W. M. Ware: "The Downy Mildew of the Hop," *Jour. Min. Agric.*, XXXI, p. 1144 and XXXII, p. 30, also "The Downy Mildew of the Hop and its Epidemic Occurrence in 1924," *Annals of Applied Biology*. XII, p. 121 (1925).

Abroad, the disease occurred, apparently for the first time, in 1925 in France, Belgium and Russia.

France.—Prof. Et. Foëx sent us, in May, 1925, hop leaves collected by Prof. V. Ducomet, at Grignon (Seine-et-Oise), attacked by a Downy Mildew which agreed well with examples observed in England. In a later communication from Prof. Foëx, the disease was reported as occurring on several different varieties in hop-gardens in the Côte d'Or, and on wild hops in districts in which hops are not cultivated. Prof. Ducomet, in a recently published article,* records the occurrence of the disease on wild and cultivated hops in various districts in France, including Alsace and Lorraine. The opinion is expressed that the disease must have been present in France before 1925, and that it is now too widespread either for steps to be taken to eradicate it, or for defensive measures relating to the importation of foreign hops to be adopted.

Belgium.—In June, 1925, Prof. É. Marchal informed us of the occurrence of the Downy Mildew in hop-gardens near Assche (Brabant), and in an account published later by P. Lindemans,† the disease is reported from other localities in Belgium. The German variety "Hallertau," which has been grown for a long time in Belgium, has been severely attacked on its shoots, and the disease has occurred also, chiefly on the leaves, on native Belgian varieties (*e.g.*, "Groene Bel") and on English varieties. It is considered by these authors that the disease constitutes a serious menace to hop-growing in Belgium. At a show held last autumn at Ternath, where samples of dried hops were exhibited, M. l'abbé de Jaegher‡ carried out an examination to ascertain what proportion of the samples exhibited showed cones attacked by the disease. Out of ninety-one samples, no fewer than thirty were found to be more or less diseased. Those varieties attacked were native Belgian varieties, the Hallertau, and an English variety ("Kent"). The disease occurred on hops particularly from the districts of Assche and Cappelle St. Ulric, and here and there in the country Alost-Assche.

Russia.—In October, 1925, Prof. A. de Jaczewski sent us the fungus on leaves and cones collected from wild hops near Wladikawkaz, North Caucasus, in which province it appears to be very common.

Germany.—As mentioned in the previous article,§ the present disease was reported during 1924 on cultivated hops in Württemberg, but no details of the outbreak had then been published. Prof. Korff has since recorded‖ a severe outbreak in 1925 in Bavaria (Wolnzach). Dr. Lang¶ has now described the circumstances attending the first appearance of the disease in 1924, and its spread in 1925, as follows: In July, 1924, the disease was noticed

* V. Ducomet: "Le Mildiou du Houblon, Maladie nouvelle pour la France." *Revue de Path. vég. et d'Entomol. agric.*, XII, 248 (1925).

† P. Lindemans: "Le Mildiou du Houblon. *Le Petit Journal du Brasseur*, XXXIII, 899 (1925).

‡ A. de Jaegher: "L'exposition de houblons de Ternath et la maladie nouvelle, *l.c.*, XXXIII, 1123 (1925).

§ *Jour. Min. Agric.*, XXXI, p. 1145.

‖ Korff: Dem Hopfenbau drohende Gefahren." *Prak. Blätter für Pflanzenbau u. Pflanzenschutz*, III, Heft 3, Juni (1925).

¶ W. Lang: "Der falsche Mehltau am Hopfen." *Nachrichtenblatt f. den deutschen Pflanzenschutzdienst*, V, nr. 8, Aug. (1925).

in the Tettnang district, one of the chief hop-growing centres of Württemberg. Fertile lateral shoots were attacked and were frequently entirely destroyed. The early varieties of hops were not affected, and produced well-developed cones ; amongst the late varieties the "Rottenburg" and "Wolnzach" suffered severely. Enclosed hop-gardens situated on the level were the most severely attacked ; those on ground sloping to the S. or W. to a less extent. A short dry period in the second half of July (1924) brought the disease to a standstill, and the subsequent continuous wet weather of August did not occasion a further development. In 1925 the fungus was reported, in the first half of June, not only from the Tettnang district, but also from another great hop-growing district in Württemberg (Horb to Herrenberg), these two districts being separated from each other by hilly country where no hops are cultivated. Dr. Lang considers that the introduction of the disease into Germany from a foreign country is out of the question, because in the Tettnang district no "sets" are imported. This author concludes that "If favoured by weather conditions, this disease may mean a very serious danger to hop-growing in Germany."* It may be noted here, as evidence of the fears aroused by the appearance of this new disease in German hop-gardens, that at the Third International Congress of Hop-growers, held in 1925, the delegate from the Württemberg district stated that, in his opinion, the new disease might prevent, in ten years, the cultivation of hops in Germany.†

In November, 1925, a sample of imported German hops ("Hallertau, 1925"), with noticeably discoloured "petals," was noticed by one of the writers, in the Borough, London. These hops had been grown in the Hallertau district of Bavaria (the chief centres of which are Wolnzach and Mainburg). Microscopic examination revealed the presence of fructifications of the Downy Mildew, both summer-spores and winter-spores (*oospores*) being found on or in the "petals" of these hops.

The Origin of the Disease.—No facts have come to light during 1925 as regards the original source of this new disease. The general evidence furnished by the outbreaks during 1925 in France, Belgium and Germany would seem to point to the importation into Europe within recent years of the present fungus either from Japan or the United States (where it has been known since 1905 and 1909 respectively). If so, the fungus has already spread so widely in these countries (as in England), attacking wild as well as cultivated hops, as to have every appearance of being a native of the countries concerned. It is certainly possible that the present outbreak is to be regarded as another case similar to that of the potato "blight" fungus (*Phytophthora infestans*) and of the Downy Mildew of the vine (*Plasmopara viticola*) which, imported into Europe from America, the first in the 'forties and the second in the 'seventies

* Dr. Lang makes the statement on the authority of Dr. Stiegler, that the disease was noticed in Czecho-Slovakia (for the first time) in 1925.

† *Le Petit Journal du Brasseur*, XXXIII, 1036 (1925).

of the last century, spread swiftly over the continent within a few years.

A second theory, which the writers advanced in 1924,* supposes that the Downy Mildew of the nettle, a species native to Europe and very closely resembling the Downy Mildew of the hop, has in recent years been able to extend its powers of infection to attack a new host-plant, *i.e.*, the hop. The results of further experiments, however, carried out by the writers in the spring of 1925, have not confirmed this view. In these experiments spores of the fungus taken from the hop were placed on leaves of seedling hop-plants, and 15 leaves (out of 22 inoculated) became infected, while no infection resulted when seedling nettles (15 leaves of *Urtica dioica* and 7 leaves of *U. urens*) were similarly inoculated.

Effect of the Disease on the Hop-plant in its Different Stages of Growth.—(*a*) *On the Bine.*—A close watch was kept for the first appearance of the disease in Kent in 1925. On April 18 a small diseased shoot was found coming up from a "hill" in the Experimental Hop-garden at Wye College. It resembled those seen in previous seasons which on account of their rigid appearance with short internodes and undeveloped leaves have been designated "spikes." All the leaves and stipules of this "spike" bore in profusion the fructifications of the mildew, the spores of which, when placed in water, germinated in about two hours. A further search was made from time to time in the garden, and by April 30 "spikes" had been found emerging from twenty-five "hills." The "spikes" are easily recognisable at a distance by their silvery-grey or greyish-green colour and rigid appearance as compared with the fresh green colour of the thin, rapidly elongating, healthy young shoots (Fig. 1). In nearly every case some or all of the leaves of the "spike" bore fructifications with spores. It is clear, therefore, that at the very commencement of the growing season of the hop the mildew is liable to appear on diseased shoots in the "hill" in an infectious form, which may spread the disease to the leaves as they are produced on the healthy bines. The recognition of these "spikes" is of the utmost importance as they are the chief primary source of infection each season, and their removal at the earliest opportunity must form the basis of any control measures adopted.

* Salmon, E. S. and Ware, W. M.: "The Downy Mildew of the Hop and its Epidemic Occurrence in 1924." *Annals of Applied Biology*, XII, 144 (1925).

FIG 1.—Downy Mildew of the Hop. *Right*: "Spiked" shoot from the rootstock, the leaves and stipules covered with quantities of spores which are spread through the hop garden. *Left*: Lower part of a healthy bine. (About ⅔ nat. size.)

FIG 2.—Leafy spike from the rootstock of a type different from that shown in Fig 1. The stem has attained a greater height and the leaves are more fully expanded. The upper surfaces of the leaves show large yellowish patches (×). On the under-surfaces corresponding to the position of these yellow areas are found black masses of summer spores. (About ⅔ nat. size.)

FIG. 3. Three hills in an affected hop garden (variety [illegible]) Lelhurst, Kent, showing the attack of Downy Mildew on the growing bine in June. Eight bines are trained from each hill. On the left all are healthy; in the centre only one is healthy and seven end in spikes; on the right all the eight bines are stunted and end in spikes. The development of healthy lateral branches below the spiked tips can be seen.

Fig. 4. A terminal spike occurring at the tip of a bine at 5–7 ft from the ground. Healthy lateral shoots arise immediately below the diseased tip which has ceased growth. Summer spores may be produced in black sooty masses on the lower surfaces of the leaves of the spike, and winter spores are found within the stem. (¼ nat. size.)

FIG. 5. *Above*. Young cones turned brown and checked in growth. This may occur at any time from the burr stage onwards. *Below*. Healthy cones which have reached maturity. ($\frac{3}{4}$ nat. size.)

During May a search was made for the disease in a large number of hop-gardens in various districts in Kent, and the "spike" form of the disease was frequently seen. In the autumn of 1924 (October) it had been discovered* that the Downy Mildew was present on the leaves of the pulled-down bines, after the hops had been picked, in a considerable number of hop-gardens between Paddock Wood and Maidstone, Kent. On May 6 one of these gardens (in the parish of Wateringbury) was visited, and during a search of twenty minutes, "spikes" were found in no less than thirty-one "hills," distributed generally over the garden. The lower leaves of the "spikes" bore fructifications of the fungus, which in some cases were so abundant that the lower surface of the leaf was almost black. Both the farmer and his bailiff stated that the disease was new to the garden, and that such "spikes," had they occurred in 1924, could not have escaped their notice.

Another early infestation was observed in East Kent (Chilham parish). In a garden of Rodmersham Goldings, "spikes" were found in about 3 per cent. of the "hills," and in an adjoining garden, planted with Tutshams, in about 1 per cent. Some of the "spikes" were very large; one measured 10 in. in height, the stem was between $\frac{1}{2}$ in. and $\frac{3}{4}$ in. thick, and the top was "bushy" with curled leaves arranged close together. All the "spikes" were noticeably pale- or greyish-green, and some showed a silvery "sheen" over the surface of the leaves. Here again the farmer and the bailiff considered that the disease was quite new, and were very sure that no "spikes" had occurred in 1924. The farmer stated that "spikes" had been noticed this season (May, 1925) also in an adjacent garden of Petham Goldings, and that approximately ten in every 100 hills produced "spikes"; as many as eight and ten had been found in a "hill."†

During May "spikes" bearing the fungus were found in several hop-gardens in the following parishes:—Malling, East Peckham, Paddock Wood, Offham, Marden. The varieties affected were Cobbs, Golding, Tutsham, Tolhurst, Fuggles, Bramling. In some cases the "spikes" were not of the type shown at Fig. 1, *i.e.*, with small, crowded, incurved leaves, but were longer, up to 20 in. high, with

* *See Jour. Min. Agric.*, XXXII, p. 32.

† The farmer expressed the opinion that it was probably the Downy Mildew that had attacked the hop-cones in this garden in 1924, as these turned brown on the outside before they were quite ripe.

fully expanded and much less crowded leaves. A shoot of this type (which may be designated a "basal leafy spike") somewhat resembles the shoot of a black currant (Fig. 2). The leaves of such "leafy spikes" frequently show on their upper surface prominent yellowish green blotches, while the lower surface at these places bears dense, blackish masses of the fructifications of the fungus. "Spikes" of this nature were found in gardens of the Tutsham and Tolhurst varieties.

On May 19 what appeared to be secondary infections were observed in a hop-garden on the leaves of healthy bines in the vicinity of "spikes." This was more clearly observed on May 31 in a garden, where approximately 1 per cent. of the hills were producing "spikes"; here, fully expanded normal leaves on healthy bines at about 5 ft. from the ground had become infected, probably by spores of the mildew produced on the "spikes," and bore on the lower surface blackish patches, composed of densely massed fructifications. It was noticed that the earliest sign of infection is the appearance of pale yellowish spots on the upper surface of the leaf. These, presumably, turn brown later, and become the "angular spot" form of the disease described and figured in a previous article.

Acting on advice given, the farmers concerned sent men through the affected gardens to search for and remove the spikes from the "hills." This operation had to be repeated at intervals during several weeks, as it was found that a succession of "spikes" might be produced, far into the summer. "Spikes" may continue to arise from a "hill" after superfluous bines have been "pulled," and the strings furnished for the season. There now seems little doubt that the prompt action taken by the growers saved these gardens from being more seriously affected later in the season.

Microscopical examination of "spiked" shoots coming up out of the "hill" showed that they were infected internally with the spawn (*mycelium*) of the fungus. Evidence was obtained that the spawn is present also in the underground parts of the hop-plant, a point in the life-history of the fungus that is referred to later in this article.

In previous years the occurrence of spiked growths on the bine had been observed, but the extent of the damage thus caused had been inconsiderable. During June, 1925, however, it was realised that in this respect the potentiality of the Downy Mildew for causing serious injury by depriving the

garden of sufficient bine was far greater than had been supposed.

The first case of such serious injury was observed on June 12 ; the affected garden* (in the parish of Wateringbury, Kent) consisted of Tolhurst hops, planted in 1921. The plants had come away well in the spring, and the strings had in due course been furnished with eight bines to the hill in the usual way. Earlier in the season this garden had been visited, and on May 19 " spikes " had been found in two hills. The bailiff stated that no basal " spikes " had been observed when the " hills " were " cleaned " on June 11. The healthy bines were from 9 to 10 ft. high, but, on entering the garden, it was apparent that a considerable number were entirely stopped in their growth up the strings, and had formed a tufted, leafy, spike-like growth at their tips. At least 70 per cent. of the hills were thus affected. Commonly two to five of the bines, or rarely all the eight trained up, terminated in a " spike." The abnormal condition of the bines had become apparent not more than a few days previously. In general, no fungus was evident on the leaves of the " spike " (probably owing to the dry weather at that time) ; very occasionally a few dark lines or spots occurred near the " veins " on the under surface of the leaf, and here the blackish fructifications of the Downy Mildew were visible. In an adjoining garden of Fuggles some 40 per cent. of the hills showed bines similarly affected with " spikes." The bailiff was very certain that no such " spikes " had occurred in either garden in 1924.

Fig. 3 shows the " hills " in the affected garden of Tolhursts, and Fig. 4 a bine bearing a terminal " spike." It can be seen that long lateral shoots had developed owing to the growth of the main bine having been stopped. Consternation was naturally felt by the farmer at the very general stoppage of the growth of the bines trained up, particularly as it seemed then not unreasonable to fear the worst, *i.e.*, that the entire " spiked " bine might be diseased. Microscopic examinations of such bines, however, showed that while the " spiked " portion of the bine contained the spawn (*mycelium*) of the fungus,† the latter was not necessarily continuous, and was

* This garden had been flooded during the winter of 1924-25. In the hedge of this garden—as is now commonly the case in many parts of Kent, "wild" hops bearing the Downy Mildew were growing.

† The pith of that part of the bine which contains spawn is turned brown.

absent from the bine at those joints (*nodes*) whence healthy laterals arose, as well as from the laterals themselves.*

The advice, therefore, the writers were able to give to the farmer in this case, as well as to hop-growers generally,† was that it would probably be safe, after the removal from the hop-garden of "spiked" tips, to train up the laterals immediately below. This practice was adopted not only in this, but in many other similarly affected gardens, and reports were received later that in all but one case the laterals trained up remained healthy. At the time, however, the consternation felt by the hop-grower at the injury so suddenly produced by the Downy Mildew to the growing bine was extreme; and, as indicating the suddenness of the attack in June it may be mentioned that three urgent calls for inspection of diseased gardens were received on the same day.‡

During June, cases of the hop-bines being attacked as described above were investigated in hop-gardens in the following parishes in Kent: Wateringbury, in a young piece of Cobb's which appeared healthy until June 12, when more than 50 per cent. of the hills showed one or more bines arrested in growth at 5 to 7 ft.; Leeds, in a Tutsham hop-garden, planted four years ago;§ Yalding, in Bramlings and Tutshams; Hunton, Canterbury Golding variety, where about 10 per cent. of the hills were affected. Specimens were also received from a Bramling garden in Worcestershire. As events proved, the ultimate injury caused in the affected gardens by the formation of "spikes" at the tips of growing bines in June was not very considerable—apart from the expense of finding labour for the removal of the "spikes" and for the training up of the laterals, at a very busy time of the year. In the case of the Tolhurst garden referred to above, the loss of crop was estimated at approximately 5 cwt., to the acre or about 25 per cent.; in another garden, the loss was estimated at 5 per cent. In a

* Bines showing "spiked" growths of various kinds have been observed in "wild" hop plants growing in the hedge, in Kent and in Devon. In the former case, the bines were more seriously affected and distorted than has been observed up to the present in hop-gardens. The occurrence of "spikes" on "wild" uncultivated hops shows that this is not connected in any way with the "cutting" process adopted in the case of cultivated hops.

† E. S. Salmon and W. M. Ware: "New Facts Concerning the Downy Mildew or 'Spike-disease' of the Hop." *Jour. Kent Farmers' Union*, XVIII, p. 21 (July, 1925).

‡ In some cases the grower had mistaken the "spiked" growths for a form of the "nettlehead" disease.

§ The farmer wrote: "The disease came all at once last week-end," a remark which indicates how rapidly the "spikes" develop on an apparently healthy bine.

third case, where about 5 per cent. of the hills (of a Golding variety) had produced bine with "spikes," and where in June the "spikes" had been removed and the laterals trained up, the farmer reported that a full crop (even heavier than in 1924) had been gathered. In all cases the crop produced was quite healthy. Reviewing the above cases, the following considerations must be kept in mind. In 1925 the weather at the time of the production of the "spikes" in June was warm and dry; in other seasons, however, the effect of the attack on the bine may well be more serious. Under certain weather conditions it may not be possible to substitute with such success the laterals for the main bine; and, should wet weather occur at the time of the formation of the "spikes," it is much to be feared that the fungus, dormant in dry weather, will break out from the leaves of the "spikes" with ferocity and cover them with spores which will spread the disease to the leaves of the lateral shoots. On this account there are reasons for grave apprehension with respect to the injury the present disease may cause in the future to hop-growing in this country.

(*b*) *On the Hop-cones.*—Serious damage to the hop-cones in commercial gardens—by far the most important aspect of this disease—was observed in two cases. In the first, the affected garden was of the Cobb's variety; the hops throughout the garden, particularly those situated along the top wires, were beginning to be affected and turned brown by the attacks of the mildew. Very occasionally a hill was found where the majority of the cones were so seriously discoloured or turned dark brown that they were ruined commercially, as the bright colour necessary for dried hops on the market would be unobtainable. Whilst probably the injury caused in this garden to the crop generally was not serious enough to affect the colour of the dried hops, there seems every reason to fear that had the picking been delayed for a few days longer, or had the weather turned wet, the whole crop might have been lost. The farmer reported that in an adjacent garden of a Golding variety, the amount of injury caused by the Downy Mildew to the cones had been sufficient to spoil the colour of the dried hops. Throughout these gardens the fungus could be found here and there on the leaves of the bines. It was noticed also that the "wild" hops in the hedges close by were heavily infected with the angular spots caused by the Downy Mildew in its spore-bearing infectious stage.

In the other case observed, a number of varieties were attacked just previous to the ripening of the crop, and such

serious injury inflicted on the cones that many became deformed and hypertrophied, while others were variously marked with brown blotches and stripes. Fig. 5 shows the damage that may be caused to young partly developed cones.

(*c*) *On "Sets" in the Nursery.*—Inspection of hop nurseries in 1925 showed that, exactly as was found in 1924, the leaves of hop sets in the autumn (September and October) become smothered with the Downy Mildew. Nurseries of hundreds of thousands of hop sets have been seen so heavily infected that the leaves, bearing the large blackish patches of the mildew in its spore-bearing stage, were curling under the attack, and the margins of the leaf dying. It is doubtful if such nurseries contained a single healthy plant. All the plants are sold from these nurseries and distributed throughout the country. As pointed out below, it has been found that the spawn of the Downy Mildew can exist during the winter in the perennial underground parts of the hop set. It appears certain therefore that the present disease is being distributed each year far and wide to freshly planted gardens through the ordinary channels of commerce.

Life-history of the Downy Mildew.—The general life-history of this fungus has been given in a previous article in this JOURNAL to which reference has been made. The winter-spores (*oospores*) are produced within the tissue of infected hop leaves; when the latter fall to the ground, the soil becomes infected with the spores, which probably infect the hop-plant the next season. During 1925 resting-spores were found in two other parts of the hop-plant—a fact of considerable economic importance. The miscroscopic examination of the terminal "spikes" produced in June on the bine at a height of 5 to 7 feet, showed that within the pith an abundant formation of winter-spores may frequently take place. It is therefore imperative that all such "spikes" be removed from the hop-garden. Winter-spores have also been found in the pith of "spiked" lateral growths. It was found, further, that when the hop cone is attacked, a production of winter-spores within the tissues of the browned "petals" (*bracts and bracteoles*) commonly takes place. Such affected cones must therefore not be allowed to fall to the ground, or the soil will become infected.

Microscopic investigations of one- and two-year-old rooted nursery plants (sets) have shown that the spawn of the fungus

may be present in the underground parts (pith, bast and cortex) of the rootstock,* and in some cases, even in the roots. The inference is that the spawn, from the underground parts of the hop-plant, travels up and infects the current year's growth, and that a hop-plant when once infected in its underground parts, may remain permanently so. Two cases have been observed in a newly-planted hop-garden where a nursery set, presumably diseased at the time of planting, has reproduced the disease, in the basal "spike" form, in the season after planting. Although the existence of perennial spawn in the "rootstock" or "crown" of hop plants in an old established garden has not yet been observed, the possibility must be faced that the present disease when it invades fresh hop-gardens may cause the "hills" to become permanently diseased.

Control Measures.—Where the Downy Mildew has been observed in a hop-garden, the following preventive measures should be taken :—

(1) From April or May onwards, the "spiked" shoots coming out of the "hills" must be searched for and promptly removed. These "spikes" are a primary source of the disease each season, and in wet weather their leaves become blackish with myriads of spores, which quickly spread the disease to the leaves of adjacent healthy bines. Stripping of the lower leaves of the bines should be carried out as soon as this operation will not affect prejudicially the growth of the bine, as these leaves are likely to become affected by the spores produced on the "spikes," or by winter-spores germinating in the soil. Proceeding stage by stage, the leaves should be removed from the bines to a height of 5 to 6 feet.

(2) Should the trained-up bines show "spiked" tips during June or later, these tips should be at once cut off and burned, and the same treatment applied to any "spiked" lateral branches that occur. The healthy laterals which arise below the "spiked" tip of the main bine may safely be trained up.

(3) When the disease has attacked the hop cones, these must be removed from the garden, as, if allowed to blow away, the winter-spores which they contain will infest the soil. It is

* E. S. Salmon and W. M. Ware : "On the Presence of a Perennial Mycelium in *Pseudoperonospora Humuli* (Miyabe and Takah) Wils." *Nature*, 116, p. 134 (1925).

W. M. Ware : "*Pseudoperonospora Humuli* and its Mycelial Invasion of the Host-plant." *Trans. Brit. Mycol. Soc.* (in the Press).

also advisable that the whole of the bine of a garden in which the disease has appeared should be collected and burnt (as soon as possible after hop-picking) so as to destroy the winter-spores present in the leaves and in any "spikes" which have escaped detection during the season.

(4) It is advisable that all "wild" hops growing in the hedges or waste places adjacent to the hop-garden be grubbed up and destroyed. It has been found that such hops almost invariably harbour the Downy Mildew.

(5) Should the above measures fail to control the disease, spraying must be tried. Bordeaux mixture is the best fungicide* to use, and the bine should be sprayed, using a nozzle throwing a fine, mist-like spray and taking care to wet both sides of the leaves. *Spraying must be discontinued before the first appearance of the "burr."*

Summary.—(1) During 1925 the Downy Mildew of the Hop (*Pseudoperonospora Humuli*) has suddenly appeared on wild and cultivated hops, over a considerable area in France and Belgium, and on wild hops in Russia; in Germany, where it was first noticed in 1924, it has now spread to the important hop-growing districts. It is regarded in the above countries as constituting a menace to the cultivation of hops.

(2) In England, a considerable number of hop-gardens in various districts in Kent have been attacked during 1925. Cases have occurred also in Hampshire and Worcestershire. On wild hops the fungus is widespread in the hop-growing counties, and has been found also in those where hops are not cultivated.

(3) The Mildew produces its "summer-spores" as early as April on "spike"-like shoots which grow out of the "hills." From these sources the leaves of healthy bines in the neighbourhood become infected.

(4) Cases have occurred in hop-gardens where the growth of a considerable proportion of the hop-bines has been seriously affected in June by the formation of "spikes" at their tips when 5 to 7 ft. high.

(5) The spawn (*mycelium*) of the fungus can persist during the winter in the underground portions of the hop-plant, and possibly grows up with the annual shoots and converts them into various forms of "spiked" growths.

* As is well-known, Bordeaux mixture has proved efficacious in controlling Potato Blight, which is caused by another of the Downy Mildews. Sulphur has in this case been found ineffective.

(6) Cases have occurred in hop-gardens where the cones were attacked and seriously damaged.

(7) Resting spores (*oospores*) of the mildew have been found in the tissues of " spikes " and also in the " petals " of the hop-cone.

(8) Certain control measures, based on the recognition and destruction of the primary sources of infection, are recommended.

MAY ON THE FARM

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Seasonal Notes.—The name of our fifth month, May, is of Roman origin, and of the various derivations suggested the one usually accepted is that the word refers to Maia, the mother of Mercury, to whom the ancient Romans sacrificed on the first day of this month. Perhaps of more agricultural interest, however, is the fact that our Saxon forefathers termed this month *Trimilki*, because they began to milk their cows three times a day at this season.

Ordinarily, May is a month of rapid growth, when the last of the trees—oak, beech and ash—assume their full summer foliage and the cornfields pass from the creeping stage to that of waving, leafy verdure. Rye comes into ear in May and, in an early season such as the present, June will probably not be far advanced before the heads of winter oats and other cereal crops appear. This is obviously an important, if not, indeed, a critical, part of the growing season for cereals. " Water in May," says the ancient husbandman, " is bread all the year," an observation which is supported by the results of investigations at the North Dakota Experiment Station, where a close relationship has been found between rainfall and tillering and between tillering and yield. Hay crops also are usually light after a dry May. On the other hand, tradition condemns a May flood.

Cleaning Land.—Green crops drilled in April—mangolds, beet, kale—are generally sown on those portions of the root break that least require cleaning in spring. Whatever may be the virtues of thorough cultivation carried out at the proper time, it is well established that excessive tillage near the time of sowing is not conducive to the best germination of mangolds

and beet. The same applies to swedes: how often I have noticed good germination on land not thoroughly cleaned, while the farmer who has made a more thorough job of killing the weeds has obtained a gappy plant or a braird that is an easy prey to the turnip fly. Where, however, the main function of the root crop is to clean the land, then the extraction or killing of perennial weeds before drilling the crop must be the first consideration. If the root crop is of more importance as a source of stock food, the rotation may have to be modified to reduce the amount of spring cleaning necessary before sowing the root crop.

On light and medium soils it is not as a rule very difficult to extract the running weeds—twitch and couch—in time to drill swedes in May or early June. Assuming the land was ploughed in autumn, the process is as follows: a layer of three inches to four inches deep is first loosened with the cultivator or the digger; the weeds are lifted to the surface, preferably with the spring tine harrow, or the drag harrow as second choice, and shaken free of soil with straight-toothed harrows. Their collection for removal is usually performed with chain harrows, but the side-delivery rake is better where it can be used without fear of breakage of tines by contact with stones. On medium soils the clods may have to be broken by rolling during the process to liberate the weeds they contain. Another layer of three inches to four inches is similarly dealt with after the first has been cleaned, commencing with a deep flat furrow.

The question of whether to use artificial manures as well as dung for the swede crop is not difficult to answer when the yard manure has not been applied until after the work of spring cleaning has been completed; artificials should certainly be applied, if possible drilled in the soil just below the seed, to ensure a more vigorous start and early growth before the roots reach the dung. Artificials are not so necessary for swedes when the yard manure has been applied in time to become decayed and well incorporated in the soil before drilling.

In cleaning heavy land, it is not generally possible to drag the weeds out in the above manner. The weeds are held firmly by the clods and on refinement of the soil break up into small living pieces. The approved method on such soils is that of drying the clods through until the weeds they contain are killed by lack of moisture. In this process it is not advisable to work the soil too fine until after the weeds have

been destroyed; operations should be confined to stirring the clods with coarse-tined implements. The cleaning of heavy land extends over part or the whole of the summer according to circumstances; but where much cleaning on these lines is necessary, it is not often possible to sow the land with any crops in May. The soil may have to lie undisturbed for a time in order that it may become mellowed, settled and moist enough for the germination of small seeds.

Side Hoeing.—By the end of May, mangolds and some of the earlier sowings of swedes will be showing in full row, with annual weeds rapidly becoming established in and between the drills. From this date onwards until about the end of July farmers wage ceaseless war against weeds in their root crops. Many, however, are apparently unaware of several valuable implements and fittings which considerably facilitate the close side-hoeing of the crop and increase the output per man. With an ordinary Dutch or push hoe a man can side-hoe perhaps one-third to one-half an acre per day; but with a double-shared hoe, mounted on a pair of wheels, he can efficiently cover one to one and a half acres in the same time. This implement will work equally well on the flat or on low ridges. The steerage horse-hoe fitted with trailing blades of the so-called "Goss and Savage" pattern is another labour-saver suitable for flat or low ridge work. These blades allow of work close to the line of seedlings without casting soil over the plants or tearing up the soil too close to their roots. For three-row work the drills must, of course, be straight and evenly spaced, and a driver is required to guide the horse in hoeing. Recently steerage hoes, fitted with discs and trailing blades, have been introduced: these have for some years been popular in the beet growing districts of the Continent; their work is somewhat similar to that of a combined disc and skim coulter.

For work on ridges mention should be made of a device, common in the North Midlands, of fitting pairs of trailing blades in place of the coulter of a two-row turnip drill; on soils free from stones or large clods, and provided that the hoe follows the pairs of rows as sown by the drill, close hoeing may be done very expeditiously with this device. In the Border districts a two-row disc scarifier is used for the same purpose and is gaining in favour. Single-row horse hoes, of the parallel expansion type, may be fitted with Goss and Savage blades for work between low ridges or special shares for higher

drills. Implements and fittings of this class call for more attention than farmers have given to them in the past. Many have no idea of reducing the amount of hand-hoeing except by grubbing the ridge away until the line of plants is left standing on a narrow crest of soil, from which the sun and wind quickly extract the last traces of moisture.

Utilisation of Milk.—If a sample of milk contains 3·6 per cent. of butter fat and is efficiently dealt with in the process of cream separation *and butter making*, 2½ gallons of it will yield 1 lb. of butter and 2¼ gallons of separated milk. The price of butter varies, but at present it is about 1s. 10d. per pound. Many experiments have shown the feeding value of separated milk to be about one-sixth that of meals, *i.e.*, 1 gallon of it is worth 1½d., and 2¼ gallons are worth 3½d. Thus the gross return from 2½ gallons of milk made into butter is 1s. 10d. +3½d.=2s. 1½d., or 10d. per gallon of milk utilised.

Where the yield of butter is less than 1 lb. per 2½ gallons of milk, tests should be made at various stages to ascertain whether butter fat is being lost, and if so where. In a case recently investigated, where more than 3 gallons of milk were required to produce 1 lb. of butter, suspicion rested on the cream separator. The separated milk, however, showed less than 0·2 per cent. of fat, which is not very high, but it was found that a very considerable part of the butter fat separated was not being recovered but lost in the butter-milk. The cause was the churning of a mixture of ripened and comparatively sweet cream.

Cream Selling.—In some districts a seasonal demand for cream may afford an opportunity of realising a good price for milk by devoting it to cream production. Ordinary good table cream contains about 35 per cent. of fat, and requires for its production about ten times its volume of milk. Its value depends on the local demand, and generally the price falls between June and September; but at 1s. 6d. per pint of cream, the return on the milk so converted is (12s.+1s. 1½d.) ÷10=1s. 3½d. per gallon.

Cream is the name for a very variable commodity. The ½ in. layer which forms on the surface of a 6 in. column of milk contains only about 20 per cent. of fat, but clotted cream contains upwards of 50 per cent. of fat. Thickening substances used to be added to give the appearance of richness, but under the Milk and Cream Regulations of 1912 such adulteration is prohibited.

NOTES ON MANURES FOR MAY

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Manuring of Swedes.—Swedes can be grown with artificials alone or with farmyard manure alone, but throughout England south of the Humber, and indeed probably south of the Tyne, there is no advantage in using both. The farmer must decide which to use, and if he is short of farmyard manure, he will probably find it better to apply artificials, using the farmyard manure elsewhere.

Of artificial fertilisers for swedes, the most important is *Phosphate*, especially where yields are likely to be low, Striking increases in crop have been obtained on some soils by the use of superphosphate and basic slag, for example, by Prof. Scott Robertson in the North of Ireland, and occasionally by others in England: Messrs. Mercer and Carr record an instance at Matley, Hyde, Cheshire, on a high-lying farm.

	Swedes Per acre		Rye grass Per acre		Oats in ear Per acre	
	tons	cwt.	tons	cwt.	tons	cwt.
(1) No phosphate	1	4	1	8	4	6
(2) Mineral phosphate	2	13	1	14	4	9
(3) Superphosphate	8	0	1	11	5*	0

* This plot ripened early and much grain was shed when weighed.

On ordinary farms if the land is in good condition and has received dung, or if the season be favourable to good growth, phosphates may have but little effect on yield. This is well seen in contrasting the poor year 1920 with the good ones 1922 and 1924. Our Rothamsted results in tons per acre were:—

	Poor years		Good years	
	1913	1920	1922	1924
No artificials	3·2	3·3	25·2	17·3
No *phosphate*, but only sulphate of potash and sulphate of ammonia	6·4	9·3	28·1	19·1
Phosphate (slag, 1922, or superphosphate, 1924, in addition)	8·6	16·3	29·0	20·6

In 1920 the superphosphate (2½ cwt. per acre) increased the crop by no less than 7 tons per acre, and converted the small crop of 9·3 tons into the very useful one of 16·3 tons, but in neither of the good years did even the complete manure add more than 4 tons per acre to the yield, and of this the phosphate contributed but little; the slag gave an extra ton per acre, and 3½ cwt. superphosphate increased the yield only by 30 cwt. per acre, not a very profitable proposition. On the other hand, the results of 1913 show that superphosphate

does not act equally well in all bad seasons; in 1920 the failure had been due to cold, sunless weather; in 1913 it was due to drought, and neither superphosphate nor any other fertiliser avails much against drought. If we could predict the season we should recommend dressings of superphosphate for a cold, poor-growing season, and little or no manuring for a good season or a year of drought. As, however, we cannot predict the season, and as the livestock is at stake, it is wisest to prepare always for years like 1920 rather than hope for seasons like 1922.

Of the various phosphates, superphosphate has given the best result at Rothamsted, the yields in tons per acre being :—

	No phosphate	Superphosphate	Basic slag	Bone meal
1908 ..	14·1	16·9	13 8	16·7
1913* ..	6·4	8·6	6·6	7·4
1920 ..	9·3	16·3	15·8	8·6

* Many of the young plants died through want of rain; more seed was sown, but failed to grow.

Superphosphate has also the advantage that it generally hastens development so that the young plant is ready sooner for hoeing; in some seasons this is a great advantage. There are, however, instances where basic slag proved best, usually on land subject to finger-and-toe, a disease that is not troublesome at Rothamsted. Usually the high soluble slag has proved better than the low soluble, and it does not appear that the low soluble is improved by being ground more finely.

Fear is sometimes expressed that superphosphate may make the soil acid. This possibility has been carefully studied at Rothamsted, both on the Rothamsted and Woburn soils, but no sign of increasing acidity has been discovered. The fear is a very persistent one, and it would be interesting to know how it has arisen; and if a case were found we should welcome an opportunity of examining it.

Nitrogenous Manures.—Many experiments show that sulphate of ammonia applied with the seed increases the crop, 1 cwt. of sulphate of ammonia giving about an extra ton of swedes per acre, whether the season is good or bad :—

	1922 Good season		1923 Poor season	
	Dung	No dung	Dung	No dung
Potash and phosphates only ..	30·6	26·7	14·3	13·2
2 cwt. sulphate of ammonia in addition	32·6	29·1	16·7	15·7
Gain from 2 cwt. sulphate of ammonia	2·0	2·4	2·4	2·5
Gain per cwt. sulphate of ammonia	1·0	1·2	1·2	1·2

As usual, the effect of nitrogen is remarkably steady, in sharp contrast with the varying effects of phosphates. In 1924 the dressing was varied to test the effect of using larger amounts, but it did not appear that there was any advantage in going beyond 1½ cwt. per acre.

Sulphate of ammonia, cwt. per acre ..	0	¾	1½	2¼
Yield of swedes in tons per acre	25·7	26·1	28·2	27·4
Gain from sulphate of ammonia	—	0·4	2·5	1·7
Gain per cwt. sulphate of ammonia ..	—	0·5	1·7	0·8

It is not yet certain whether the nitrogen is better applied with the seed or later, but some of the experiments suggest that the later application is somewhat better. It would be interesting to study the effect of the time of application of nitrogenous manure on the incidence of mildew; early sowing seems to increase the liability to mildew in the south: happily Scotland does not suffer so badly, and it would be useful to know if nitrogenous manure applied with the seed had the same effect; if so, the latter application would obviously be better.*

Potassic Manures.—Potassic fertilisers have no very marked effects in the south, but they are more useful in the north where the growing season is longer, and where, therefore, it is an advantage to keep the crop growing as long as possible.

Nitrogenous Top Dressings for Sugar Beet.—An experiment carried out at the Midland Agricultural College† brings out an important point connected with the nitrogenous manuring of sugar beet. It is a general rule that an increased dressing of nitrogenous manure increases the size of the crop, but it somewhat reduces the percentage of sugar in the roots :—

Nitrate of Soda applied, cwt. per acre	1	2	2½	3	4	5
Per cent. of sugar in crop ..	18·5	18·3	17·2	17·2	17·2	16·1
Yield of sugar, cwt. per acre	33·8	34·8	33·5	33·3	33·4	30·0

As a result the yield of sugar per acre does not increase as much as the size of the crop, and may indeed fall off. The experiment shows the necessity of ascertaining how far it is safe to go on using top dressings ; something must be given, but not too much.

Sodium Salts for Mangolds.—On several occasions it has been shown that sodium salts, whether in the form of agricultural salt of or nitrate of soda, are advantageous to mangolds, and this is confirmed by some experiments on mangolds,†

* Mr. Carr informs the writer that in Kincardineshire top dressings of nitrate of soda are found very useful, especially after a wet June or July.

† Bull. No. 5, 1925.

in which nitrate of soda gave better results than other nitrogenous compounds, although all were given in equivalent quantities.

Loss of Phosphates from Grass Land.—The Rothamsted experiments have shown that no appreciable loss of phosphate occurs from arable land. Under the much wetter conditions of North Wales, distinct evidence of sinking of the phosphate in the soil of grassland has been observed by Mr. J. O. Jones, of Bangor. This is an interesting point with important bearings on fertiliser practice.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ended April 21				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	14 2	13 10	13 7	13 10	17 5
" lime (N. 13%) ..	..	12 10	..	12 7‡	19 0
Sulphate of ammonia—					
Neutral (N. 21·1%)	13 1*	13 1*	13 1*	13 1*	(N.)12 4
Kainit (Pot. 20%)	3 12	3 0	..	..	..
" (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
" (Pot. 20%)	..	..	3 9	3 3	3 2
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate " (Pot. 48-51½%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 34%)	..	..	3 9§	3 5§	1 11
" (T.P. 30%)	..	2 15§	3 0§	2 17§	1 11
" (T.P. 28%)	..	2 9§	..	..	..
" (T.P. 26%)	..	2 3§	..	..	..
" (T.P. 24%)	..	1 19§	2 3§	..	..
Ground rock phosphate (T.P.58%)	2 17¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 14	3 5	1 10
" (S.P. 32%) ..	..	..	3 11	..	..
" (S.P. 30%) ..	3 0	2 17	3 7	2 18	1 11
Bone meal (N. 3¾%, T.P. 45%) ..	8 15	8 5	8 10	7 15	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 2†	6 10†	5 15	5 10	..
Fish guano (N. 6½%, T.P. 10%) ..	..	..	..	7 17	..

Abbreviations: N. = Nitrogen; S.P. = Soluble Phosphate; T.P. = Total Phosphate; Pot. = Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in 4-ton lots in the home counties.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are f.o.r. at Northern London Stations. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton.

MONTHLY NOTES ON FEEDING STUFFS

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The Role of Accessory Food Factors in Stock Feeding.—During the nineteenth century the science of nutrition taught that the essential constituents of a diet should consist of protein, carbohydrate, fat and mineral salts in adequate amounts, and feeding standards were established which laid stress on the necessity of providing an adequate supply of protein, and a sufficient amount of organic material or energy-producing substances to maintain normal growth and health. Such standards have been accepted in Germany and elsewhere, and with few exceptions have proved sound in their general applicability to modern feeding practice. The data upon which these standards were based were obtained from experiments in which diets were used consisting chiefly of naturally occurring foodstuffs. With the general progress in nutritional research experimental studies were carried out in which *chemically pure* protein, fat, carbohydrate, and mineral salts were fed. Such studies immediately resulted in the recognition that certain other accessory substances were necessary for a diet to be regarded as efficient, since in their absence malnutrition occurred. Moreover, these substances were present in small amounts, and exerted a nutritive function out of all proportion to the extent to which they were present. These accessory substances, which exist in naturally occurring foodstuffs in exceedingly small amounts, and which are of such an extreme nutritive importance, are known as " vitamines."

Mineral Salts.—Apart from these accessory food substances, " vitamines " more attention is being paid to the mineral salts of the diet, and the labours of the Rowett Research Institute have shown that the somewhat neglected group of substances comprised under the general term " ash " may, under certain conditions of nutrition, exert a nutritive influence out of all proportion to their normal physiological value. Moreover, whereas errors of malnutrition due to " vitamines" are normally associated with diets consisting largely of treated or refined foodstuffs, those due to mineral deficiencies are often met with in naturally occurring foodstuffs, and are therefore of more importance from the stock

feeding standpoint, where the diet is normally mainly comprised of naturally occurring feeding stuffs.

The occurrence of "bent leg" in sheep and the variation in the nutritive value of "fatting" and non-fatting pastures have been shown by the Rowett Research Institute to be associated with mineral deficiencies in the diet.

Nutritional disturbances in farm stock due to the absence of "vitamines" are not of very frequent occurrence, but "vitamines" are, nevertheless, of such vital importance that they cannot be ignored by the farmer as possible factors in malnutrition. Previous references to "vitamines" have appeared in these notes, and it is unnecessary to recapitulate the whole story again. Sufficient new information has, however, been obtained to merit a brief account of the present position of our knowledge on "vitamines."

Recognised "Vitamines."—Five "vitamines" are now recognised: (1) Fat soluble A vitamine, which is present in animal and fish oils and green feeding stuffs. It is essential to growth, is heat stable, and appears to be necessary for the growth of all animals, although evidence shows that fowls require a very small amount of this vitamine for normal growth. (2) Water soluble B vitamine (antineuritic), the absence of which causes a form of neuritis with paralysis. It is present in cereal grains, and birds are particularly sensitive to its absence from a diet. (3) Water soluble C vitamine (antiscorbutic) is easily destroyed by heat, and its absence from a diet gives rise to scurvy. Man and the guinea pig are pecularily susceptible to the absence of this vitamine, whereas birds appear to be able to dispense with vitamine C altogether. (4) Fat soluble D vitamine (antirachitic) was formerly grouped with Fat soluble A. Its absence from a diet gives rise to rachitic symptoms. By suitable exposure to ultra-violet light, the onset of rickets in an animal fed on a diet deficient in fat soluble D vitamine may be delayed or even prevented. (5) Vitamine E has been described by Evans and Bishop, who showed that absence of this vitamine from a diet led to sterility. This vitamine is heat resistant, and is present in wheat germ oil. It is present in oats, maize, lettuce, lucerne, and in small amounts in animal tissues. In the male, absence of this vitamine from a diet gives rise to degeneration of the testes, and in the female temporary sterility occurs which lasts as long as the diet remains deficient in this vitamine.

DESCRIPTION	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British..	—	—	12 0	0 15	11 5	72	3 2	1·70	9·6
Barley, British feeding ..	—	—	7 10	0 12	6 18	71	1 11	1·03	6 2
„ Canadian No. 4 Western	29 0	400	8 2	0 12	7 10	71	2 1	1·12	6·2
„ American	27 9	„	7 15	0 12	7 3	71	2 0	1·07	6·2
„ Russian	27 9	„	7 15	0 12	7 3	71	2 0	1·07	6·2
Oats, English, white	—	—	8 17	0 13	8 4	60	2 9	1·47	7·6
„ „ black and grey	—	—	8 13	0 13	8 0	60	2 8	1·43	7·6
„ Scotch, white	—	—	9 10	0 13	8 17	60	2 11	1·56	7·6
„ Canadian No. 2 Western	29 0	320	10 3	0 13	9 10	60	3 2	1·70	7·6
„ „ No. 3 „ ..	27 0	„	9 8	0 13	8 15	60	2 11	1·56	7·6
„ „ feed	24 3	„	8 10	0 13	7 17	60	2 7	1·38	7·6
„ American	24 6	„	8 12	0 13	7 19	60	2 8	1·43	7·6
„ Argentine .. .	22 6	„	7 17	0 13	7 4	60	2 5	1·29	7·6
Maize, Argentine	31 6	480	7 7	0 12	6 15	81	1 8	0·89	6·8
„ South African	31 6	„	7 7	0 12	6 15	81	1 8	0·89	6·8
Beans, English winter.. ..	—	—	10 10	1 11	8 19	66	2 9	1·47	20·0
Peas, „ dun	—	—	11 0	1 7	9 13	69	2 10	1·52	18·0
„ „ maple.. ..	—	—	11 13	1 7	10 6	69	3 0	1·61	18·0
Dari, Egyptian.. .. .	—	—	11 10	0 15	10 15	74	2 11	1·56	7·2
Millers' offals—									
Bran, British	—	—	6 5	1 6	4 19	42	2 4	1·25	10·0
„ broad	—	—	7 10	1 6	6 4	42	2 11	1·56	10·0
Middlings, fine, imported .	—	—	7 12	1 1	6 11	69	1 11	1·03	12·0
„ coarse, British .	—	—	6 7	1 1	5 6	58	1 10	0·98	11·0
Pollards, imported .. .	—	—	5 17	1 6	4 11	60	1 6	0·80	11·0
Meal, barley	—	—	9 7	0 12	8 15	71	2 6	1·34	6·2
„ maize	—	—	8 10	0 12	7 18	81	1 11	1·03	6·8
„ „ South African ..	—	—	7 2	0 12	6 10	81	1 7	0·85	6 8
„ „ germ	—	—	7 10	0 18	6 12	85	1 7	0·85	10·0
„ „ gluten feed ..	—	—	9 5	1 6	7 19	76	2 1	1·12	19·0
„ locust bean	—	—	9 5	0 9	8 16	71	2 6	1·34	3·6
„ bean	—	—	12 5	1 11	10 14	66	3 3	1·74	20·0
„ fish	—	—	18 0	4 1	13 19	53	5 3	2·81	48·0
Linseed									
„ cake, English, 12% oil	—	—	12 5	1 16	10 9	74	2 10	1·52	25·0
„ „ „ 10% „	—	—	11 17	1 16	10 1	74	2 9	1·47	25·0
„ „ „ 9% „	—	—	11 12	1 16	9 16	74	2 8	1·43	25·0
Soya bean „ 6% „	—	—	11 0	2 11	8 9	69	2 5	1·29	36·0
Cottonseed cake, English, 5½%„	—	—	5 15	1 13	4 2	42	1 11	1·03	17·0
„ „ Egyptian, 5½% „	—	—	5 10	1 13	3 17	42	1 10	0·98	17·0
Decorticated cottonseed cake, 7% oil	—	—	9 15	2 11	7 4	71	2 0	1·07	35·0
Decorticated cottonseed meal, 7% oil	—	—	10 0	2 11	7 9	74	2 0	1·07	35·0
Ground nut cake, 7% oil ..	—	—	8 5	1 15	6 10	57	2 3	1·20	27·0
Decorticated ground nut cake, 7% oil	—	—	11 15†	2 13	9 2	73	2 6	1·34	41·0
Palm kernel cake, 6% oil ..	—	—	6 10	1 2	5 8	75	1 5	0·76	17·0
„ „ „ meal, 6% oil	—	—	6 15	1 2	5 13	75	1 6	0·80	17·0
„ „ „ meal, 2% oil	—	—	5 10	1 3	4 7	71	1 3	0·67	17·0
Feeding treacle.. .. .	—	—	6 12	0 9	6 3	51	2 5	1·29	2·7
Brewers' grains, Dried ale ..	—	—	6 12	1 3	5 9	49	2 3	1·20	13·0
„ „ „ porter ..	—	—	6 2	1 3	4 19	49	2 0	1·07	13·0
„ „ Wet ale ..	—	—	0 19	0 9	0 10	15	0 8	0·36	4·8
„ „ „ porter ..	—	—	0 14	0 9	0 5	15	0 4	0·19	4·8
Malt culms	—	—	6 5*	1 13	4 12	43	2 2	1·16	16·0

* At Bristol. † At Hull.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 3d.; P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows :—

	Starch equivalent	Protein equivalent	Per ton £ s.
Barley (imported)	71	6·2	7 17
Maize	81	6·8	7 7
Decorticated ground nut cake	73	41·0	11 15
„ cotton cake	71	34·0	9 15

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 1·93 shillings, and per unit protein equivalent, 2·28 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1925, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	8 1
Oats	60	7·6	6 13
Barley	71	6·2	7 11
Potatoes	18	0·6	1 16
Swedes	7	0 7	0 15
Mangolds	7	0 4	0 14
Beans	66	20	8 14
Good meadow hay .. .	31	4·6	3 10
Good oat straw	17	0·9	1 15
Good clover hay	32	7·0	3 18
Vetch and oat silage .. .	13	1·6	1 9
Barley straw	19	0·7	1 18
Wheat straw	11	0·1	1 1
Bean straw	19	1·7	2 0

MISCELLANEOUS NOTES

Skill in Manual Work on the Farm

THE Ministry has lately given much thought to the question of increasing the skill of farm labourers in farming operations such as ploughing, hedging and ditching, thatching, draining, rick-binding and sheep shearing. In many counties, the educational scheme includes provision for some sort of instruction in one or more of these manual processes, and in this way a certain amount of good is done,

but it is too spasmodic to be readily effective in meeting the situation. The holding of ploughing and kindred matches is also a step in the right direction, but here also the competitions tend to bring into the limelight a very limited number of champions, rather than to increase the skill of the average labourer.

The subject is of very great importance, for, after all, the success of farming depends not only on the efficiency of the management of the farm, but on the skill of the workers who are employed, and it is as important to pay attention to the latter side as to the former. The education authorities alone cannot hope to raise the standard of farming operations to any marked degree. Farmers themselves must co-operate actively if the skill of the labourers who work for them is to be improved. Apart from the question of paying higher wages for better work, two lines of co-operation may be indicated. The first, and probably the most effective wherever practicable, is for the farmers to assume personal responsibility for the instruction of their men. The second is for the farmers in the various county areas to combine to secure, in conjunction with the local education authority, a definite scheme of instruction. This combination is necessary, not only to stimulate interest among the men for whom the instruction is intended, but to produce a sufficient demand for the services of instructors who would be employed by local education authorities. Side by side with the instruction, competitions might be held annually in sufficient classes to include all ages and degrees of efficiency. Substantial prizes for these competitions might be given, and in addition the attaining of a certain standard of efficiency by any labourer might be recognised by the issue of a certificate either by the local authority direct or possibly by the Ministry on the recommendation of the local authority. The instruction and the competitions should not be limited to agricultural labourers, but should also include farmers' sons.

* * * * * *

Agricultural and Veterinary Research Scholarships

THE Ministry invites applications for research scholarships in agricultural and veterinary science. The number to be awarded will not exceed seven, and will depend upon the qualifications of the candidates. The scholarships are tenable for three years from October 1, 1926, and are of the value of £200 per annum ; extra allowances may be made for travelling and subsistence for periods spent abroad. Applications must

be received not later than June 30, 1926, on the prescribed form (900/T.G.), which, together with a copy of the conditions attaching to the scholarships, may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Agricultural Research

THE Ministry is prepared to receive, not later than May 15 next, applications for grants in aid of scientific investigations bearing on agriculture, to be carried out in England and Wales during the academic year commencing October 1, 1926. The conditions on which these grants are offered are set out on the prescribed form of application (A. 53/T.G.), of which copies may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Agricultural Scholarships

THE Ministry invites applications for agricultural scholarships for students who propose to take up posts as agricultural organisers, teachers or lecturers in agriculture, etc. The number to be awarded will not exceed five and will depend upon the qualifications of the candidates. The scholarships are tenable for two years from October 1, 1926, the second year of which will normally be spent abroad. The value of the scholarships will vary according to the scholar's means, but will not exceed £200 per annum whilst the scholar is in this country ; extra allowances may be made for travelling and subsistence for periods spent abroad. Applications must be received not later than June 30, 1926, on the prescribed form (A. 189/T.E.), which, together with a copy of the conditions attaching to the scholarships, may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

* * * * * *

Stud Goat Scheme, 1926-27

THE Ministry has decided to continue the scheme inaugurated two years ago, under which smallholders and cottagers who keep milch goats are enabled to obtain the services of first-class stud goats for breeding purposes at a maximum fee of 5s. During the season just concluded, over 89 stud goats were registered under the scheme, and 1,115

services given, a satisfactory increase over the corresponding figures for previous seasons.

The scheme is again being administered by the British Goat Society, and no stud goat can be accepted which has not been entered or is not considered eligible for entry in the Society's Herd Book. Applicants, however, need not necessarily be members of the Society. Applications by owners of stud goats to have them registered under the scheme should be made, not later than June 1, direct to the Honorary Secretary at 10 Lloyd's Avenue, E.C.3, who will be pleased to furnish full particulars and application forms.

* * * * * *

Spraying of Fruit Trees with Arsenate of Lead: Danger to Bees

THE Ministry again desires to bring to the notice of fruit growers throughout the country the danger which may be caused to bees by the spraying of fruit trees *when in open blossom* with washes containing arsenate of lead. It is not desired to discourage the use of arsenate of lead sprays, as these are of the greatest value in controlling the winter and other moths, the larvæ of which are responsible for an enormous amount of damage to fruit trees. Spraying with this insecticide, however, should be restricted, as far as possible, to two definite periods, viz., before the blossom buds open and immediately the petals have fallen. In the case of apples, an application during the earlier period will give better results than at any subsequent time. Spraying during the actual blossoming period is particularly to be deprecated on account of the fact that heavy mortality may be caused to bees visiting blossoms on which the spray has fallen. It is realised that, as the different varieties of fruit trees do not come into blossom at the same time, it may be a matter of some difficulty to arrange that no open blossoms whatever are sprayed, but instances have been brought to the notice of the Ministry of the indiscriminate spraying of open blossom with lead arsenate, for which no reasonable excuse can be put forward.

Bees are of great value to the fruit grower by the assistance they render in the fertilisation of fruit blossom; and in his own interests, therefore, as well as for the sake of the beekeeper, the fruit grower should spare no effort to avoid any unnecessary mortality among these beneficial insects.

The Ministry will be glad to receive particulars of any cases where the death of bees in any considerable numbers appears to be due to spraying of this nature.

Demonstrations at Rothamsted Experimental Station

A CORDIAL invitation is again extended to Farmers and Farm Workers' Associations and Clubs, Chambers of Agriculture and Horticulture, Students' Societies and other bodies interested in agriculture or market gardening, to inspect the Rothamsted Experimental Plots during the coming Summer. Mr. H. V. Garner, M.A. (Camb.), will be available to demonstrate the Plots at any time, and all who come can be certain that under his guidance their visit will prove both useful and interesting.

Among important items of interest are: experiments on the manuring of arable crops, especially oats, wheat, barley, mangolds, potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land and hay land; inoculation of lucerne; crop diseases and pests; demonstrations of good types of tillages. At any convenient time between May and October 30, there is sufficient to occupy a full day, and there is provision for assuring that the time shall not be lost, even if the weather turns out too bad to allow of close investigation of the fields.

The Director of the Station, Sir John Russell, will be happy to arrange full details with organisations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. If possible, arrangements should be made beforehand; but it is recognised that farmers' movements must often depend on the weather, and no farmer need stay away because he has been unable to write fixing a date.

All communications and requests to visit the Station should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden. It would be a convenience if ample notice could be given as so to avoid the possibility of dates clashing.

* * * * * *

Report on Fungus Diseases of Crops, 1922-24

THE Ministry has just published a Report on the Occurrence of Fungus, Bacterial and Allied Diseases of Crops in England and Wales for the years 1922 to 1924.* This report is a continuation of the series which commenced in 1917, and the wide basis of the survey warrants the assumption that no important disease of any crop has escaped notice. The number of diseases listed is somewhat greater than that in the previous report for 1921-22, but this

* Miscellaneous Publications, No. 52, obtainable from the Ministry, price 4s. net, post free.

increase is mainly due to the fact that a considerable number of additional host crops have been admitted to the list, particularly pasture plants and horticultural crops. The report takes each crop in turn and gives an account of the extent to which it suffered during the three years from each disease to which it is subject. Notes are added on measures of control, legislation, and recent research in connection with the diseases, including some of the more important investigations made abroad. An attempt has also been made to indicate the intensity of attack in the case of many diseases, and to compare one season with another in this respect.

The report should prove of great value to students and writers on the subject, and to the agricultural and botanical departments in colleges and research institutes.

Foot-and-Mouth Disease

Susceptibility of Pigs: Importance of prompt reporting.—The history of recent outbreaks of foot-and-mouth disease shows clearly that one of the greatest sources of danger is the pig. In the outbreaks which have been confirmed since January 1, 1926, pigs were the animals first to be affected in seventeen cases, and seven of these commenced entirely new centres of disease. The Ministry therefore appeals specially to pig owners to co-operate to the fullest extent in the measures now being taken to eradicate foot-and-mouth disease from this country.

The conditions under which pigs are kept frequently render them liable to contract infection, and it is probable that in many cases illness may be attributed to other causes even when actually due to foot-and-mouth disease. The serious outbreaks of 1922 and 1923-24 originated with pigs, and the subsequent disastrous development of those outbreaks affords the strongest argument for keeping the closest observation on all animals, especially pigs, in order that any symptom which bears the slightest resemblance to foot-and-mouth disease may immediately be reported to the police, as required by law, with a view to investigation. Wherever a number of animals fall lame suddenly, there is a strong possibility that the cause may be foot-and-mouth disease, and in these circumstances particularly, early notification is imperative. Stockowners are reminded that failure to report without delay renders the offender liable to heavy penalties under the Diseases of Animals Acts.

It is recognised that the existence of a suspected outbreak may involve the temporary imposition of restrictions as a measure of precaution, but these are at once removed if the suspicion is proved to be unfounded. The Ministry thinks that stockowners and others concerned will appreciate that it is preferable to suffer this temporary inconvenience rather than that, owing to neglect or delay in reporting promptly, the disease should become established and be spread to other farms, thus involving a serious prolongation of the restrictions, not only in the immediate vicinity, but in distant parts of the country to which infected animals may have been sent.

Pig owners would also be well advised to see that neither scraps of imported meat, not the refuse of imported vegetables, are fed to their pigs or any other animals on the premises without first being boiled.

A leaflet describing the symptoms of foot-and-mouth disease may be obtained gratis on application to the Ministry of Agriculture and Fisheries, Whitehall Place, S.W. 1, and a leaflet of advice to stockowners is also available, copies of which may be obtained at most police stations.

Certification and Registration of Seeds

IN view of the attention which is being given in this country to the certification and registration of the seed of certain field crops, the following extract from an article which appeared in the issue of the "Journal of the American Society of Agronomy" for August last is of interest as showing the methods which are being adopted in the United States and Canada. It appears that experience in these countries shows that the certification of seed crops can best be carried out by independent organisations or associations of farmers co-operating closely with the state college of agriculture :—

> *Classification of Seed Stocks.*—The seeds sold by association members should be classified according to their breeding purity, germination, and conditions under which grown and harvested. The classes and grades of seeds are usually as follows: Elite seed, Registered and Certified seed.
>
> By the term *Elite seed* is meant a pure stock of seed originating directly from a single plant, the progeny of

which has been proved in plot or field tests under the supervision of the agronomy department of the state agricultural college, and has shown itself to be worthy of distribution; or, a stock of seed, not necessarily pure, but which has proved itself worthy of special recognition after proper plot or field trials have been conducted. The latter reference applies to that class of plants which are naturally cross-pollinated.

By the term *Registered seed* is meant seed that is of an approved and known variety which is the progeny of elite seed or of the preceding generation of registered seed and which has been inspected in the field before harvest by an expert and reported favourably by him as regards the purity of variety, vigour and freedom from disease; which germinated up to the standard set by the association; which is sound, plump and of good colour; which on bin or sack inspection is found to be free from seeds of other cultivated plants and all noxious weed seeds; which is well cleaned and graded; which weighs not less than the standard weight per bushel for the crop concerned; and which finally has been duly registered under a certificate number.

Certified seed will include the great bulk of inspected seed produced by the association. The purpose is to make available large quantities of the improved seed of high yielding, adapted varieties at very reasonable prices. It is not eligible for inspection except on the farm which produced it. It is not necessary for the grower whose crop makes the certified grade, to renew his seed, as the crop grown therefrom on his own farm is eligible for reinspection. In the case of closely fertilised plants, certified seed may not have as high genetic purity as registered seed. This class of seed, in the case of self-fertilised plants, shall be at least 99 per cent. pure as to variety; shall be cleaned and well graded; shall be free from seeds classed as noxious, as defined in the state seed law; shall be sound and of reasonably good colour; and shall weigh not less than two pounds under the standard weight per bushel.

Seed tags in all instances shall contain the information required by the state seed law concerning percentage purity, percentage germination and date of germination test and any other necessary information.

Seed Inspection, Cleaning and Selling.—Seed is eligible for sale under the name of the association only after having passed such field inspection, sample inspection and bin inspection as authorised by the association. Field inspection of any crop shall be made when the plants are standing in the field and either approaching maturity or mature. The sample inspection shall be made of a sample of a size designated under the rules of each crop and submitted to the secretary as a fair sample of all the seed which the grower expects to sell. Inspection of seed in the bin or seed house may be made, especially of the seed stocks of the new members of the association, and this practice will be continued until the grower fully understands the proper selection and handling of seed.

Shipping tags and report postcards shall be furnished members having seed for sale. One of these postcards must be filled out and returned to the secretary immediately on the sale of each order. There shall be a different coloured tag for each class of seed sold. It is suggested that a white tag be used for elite seed, red for registered seed, and yellow for certified seed.

Any variety or strain of recognised standing of cotton, corn, oats, wheat, rice, rye, barley, cowpeas, soybeans, velvet beans, peanuts, or other field crops, which has been tested under the supervision of the agronomy department of the state agricultural college and found to possess merit, shall be considered eligible for inspection.

Seed Cleaning Equipment.—Each association member or local seed association selling seed shall purchase satisfactory seed cleaning equipment. Information concerning seed cleaners and graders may be obtained from the office of the association secretary.

Selling.—All classes of seed stocks shall be sold in sealed bags or containers, and shall have the tag as prescribed by the association attached.

Lime for Poultry Runs

THERE appears to be some confusion among poultry keepers as to what is the best form of lime to use for disinfecting poultry runs. This is probably because lime is sold in different forms and under various descriptions, *e.g.*, lime, limestone, burnt lime, quick lime, ground lime, ground quick lime. The kind of lime which is recommended by the

Ministry's Veterinary Laboratory for the disinfection of poultry runs is *ground quick lime*, in a dressing of from two to three tons to the acre. Purchasers should make sure that it *is* ground quick or burnt lime; that it has been recently burnt and ground; and should apply it to the land as soon as possible after delivery, in order to obtain the maximum disinfecting effect from it. It is obviously impracticable, on grounds of expense, to use such a heavy dressing on the whole area devoted to poultry, but the expense is fully justified for the purpose of disinfecting the comparatively small area of the chicken rearing ground, on which chicks are liable to contract such diseases as coccidiosis. Furthermore, it is recommended that the same ground be used year after year for the rearing of chicks, provided it is disinfected every year by a dressing of ground quick lime at the rate mentioned above. No injurious effects to the land, or to the chickens, need be anticipated from such a dressing, though it is desirable that the lime should be applied not less than a week before the chicks come on to the land. In order that the ground may be ready by the beginning of the breeding season, the lime should be applied some time between September and December, preferably during a spell of dry weather.

Further information on the subject of lime is given in an article entitled "What is Ground Lime," which appeared in the February, 1923, issue of this JOURNAL.

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Success of Untrained Smallholders

IN the course of an inspection of certain statutory smallholdings in the north of England, the District Commissioner of the Ministry has noted an unusual and suggestive instance of the success of untrained men in the rather difficult and speculative industry of market-gardening. The men in question are two brothers-in-law who lost their employment after the War, and rather than "go on the dole" decided to make a living from the land. These men rented 7½ acres of bare arable land at a rental of £3 per annum from the local smallholding society, and on it erected two bungalows —each containing two bedrooms, a sitting-room, and small kitchen—and two glasshouses which they bought in sections, one measuring 100 ft. by 40 ft., and the other 100 ft. by 20 ft. Later, they put up a smaller glasshouse and a potting shed. With this equipment and with the aid of knowledge got from text-books—neither of the men had had any previous training in agriculture or horticulture—they have been successful in

growing tomatoes and cucumbers in the summer, and chrysanthemums for blooms in the winter, so much so that they are now ready to buy land to secure and increase their business.

* * * * * *

False Description in Sale of Barley Meal

A CASE of considerable interest to farmers and poultry-keepers was recently heard at the Tower Bridge Police Court. The Ministry instituted proceedings against a firm of millers for falsely applying the description "Barley Meal" to an article which was not barley meal, but a mixture of barley meal and barley husk, the latter in considerable proportion. The sellers were convicted, and a fine of £10 and 30 guineas costs was imposed.

It has been suggested from time to time, that the term "Barley Meal" may properly be used to describe any article which is the product of nothing but barley. Apparently those who advance this view consider that ground barley husk by itself might be described as "Barley Meal." The decision in this case goes to show the incorrectness of this view, and to establish the opinion of the Ministry that "Barley Meal" is commercially pure barley ground.

* * * * * *

Seed Potatoes

PROCEEDINGS were recently instituted in the Sheriff Court, Glasgow, at the instance of the Board of Agriculture for Scotland, against a Scottish firm who supplied, through an English merchant, seed potatoes described as of "Great Scot" variety, the crops from which were found to contain some 20 per cent. of rogues. The defendants pleaded guilty and were fined £3.

The Regulations made under the Seeds Act require, in effect, that seed potatoes described as of any specific variety shall be true to that variety as regards at least 97 per cent. In addition to the statement as to the variety of the seed, the seller is required to furnish the buyer with written particulars as to the class and the size and dressing of the potatoes.

* * * * * *

Beet Sugar in Canada

INFORMATION issued by the Natural Resources Intelligence Service at Ottawa last year shows that the expansion of the sugar beet industry in the counties of Kent, Lambton, and Essex, is one of the most successful developments in the Province of Ontario. Prior to 1902 some farmers in that part of the Province

were growing sugar beets for refineries operating in the State of Michigan, U.S.A., and realising the possibilities of the soil in this area, certain Canadians were successful in obtaining a considerable investment of American money for the establishment, in that year, of a beet sugar refinery at Wallaceburg, having a capacity of 1,250 tons per day. Since 1916, the Dominion Sugar Company has also been operating a refinery in Chatham with a capacity of 1,500 tons per day. The importance of the sugar beet industry may be judged from the fact that the acreage grown by farmers associated with the enterprise has increased from 6,927 acres in 1909 to over 31,000 acres in 1924, a gross revenue of approximately 2,500,000 dollars being realised in the latter year. The average tonnage per acre has also steadily increased and reached about 9·5 tons in 1924 ; while the average test of sugar in the beet, which in the early days of the industry ranged from 12 to 15 per cent., has also risen, 13 to 18 per cent. now being generally obtained, and some individual tests have shown a sugar content as high as 24·6 per cent. To the close co-operation of the Sugar Company with the beet growers, this improvement may be largely attributed, the agricultural experts of the Company paying periodical visits to the beet fields, taking samples of beet, testing for sugar content, acting in an advisory capacity during the weeding, thinning, growing and harvesting seasons, and arranging the timely distribution of the necessary labour. In this last respect, it has long been recognised that natives of Holland and Belgium are experts in sugar beet cultivation, and the Federal Department of Immigration gives every assistance and facility to the Company's representatives when they select skilled beet workers annually in those countries. These immigrants enter Canada as agricultural workers, but many of them eventually acquire holdings and become prosperous farmers. The plant at Wallaceburg, Ontario, is in operation practically throughout the year. Refining from local-grown beets commences on October 1, and continues for about 120 days, giving employment to about 700 workers ; and, excluding the time required to clean and change the machinery, the refining of imported cane sugar is carried on during the balance of the year, providing employment for about 450 men. Developments are also taking place in Alberta, where the irrigated areas of the south are considered to be admirably adapted for growing sugar beets, and tests of the product of farms in this area have shown an unusually high sugar content. An American Syndicate which has made a success of sugar operations in Utah, Montana and elsewhere, is erecting a factory

at Raymond, and it is understood that this is only one of a number of beet sugar plants that it is proposed to establish. In Manitoba, also, a number of farmers have planted small areas this year to test the suitability of the soil conditions for sugar beet growing.

United States Co-operative Marketing Bill

A BILL, known as the Co-operative Marketing Bill, was recently introduced by Representative Haugen into the House of Representatives, Washington. This Bill, which has the support of the National Council of Farmers' Co-operative Marketing Associations, proposes that the Secretary of Agriculture shall establish a division of co-operative marketing in the Bureau of Agriculture Economics of the department, which division, through research, educational and service work, would render assistance to co-operative associations. The Department of Agriculture has done from its inception a great deal of work with respect to the improvement of methods of production; in fact, its early activities were confined largely to matters affecting the production of agricultural products. In recent years it has done considerable work with respect to marketing. It is the purpose of the Bill to enlarge the activities of the department so that they may keep pace with the growth and development of the co-operative movement. It is intended that this Bill, if enacted, will enable the department to do for the marketing of agricultural products, through co-operative associations, work of a character analogous to that which it has always done in regard to production. The Bill does not provide for Government control or supervision, nor for the subsidising of the co-operatives. This Bill proposes to enable the Department of Agriculture greatly to increase the service which it renders co-operatives. It is contemplated that this would be done principally through research work covering the various business problems with which co-operatives are confronted and in regard to other phases of co-operative activity. The educational work contemplated would be analogous to the work which the department has done and is doing in regard to the production of agricultural products. In connection with the foregoing the employment of commodity specialists is provided for who would be familiar with the needs of co-operative organisations on the one hand and with the research and service work of the department on the other, and they would disseminate current crop and market informa-

tion, data regarding price trends, conditions of supply and demand, and other information pertaining to marketing.

The Bill also provides for the acquisition and dissemination, by associations of farmers, of crop and market information. It is highly important that associations should be allowed to keep their members fully informed in regard to all of the factors affecting the demand for their products. It is generally known that farmers, due to the large number of them and to their widely scattered geographical situation, proceed in many respects unintelligently in regard to the production and marketing of their products. The provision in question would tend to alleviate this condition.

Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on April 12, at 7 Whitehall Place, S.W. 1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following orders carrying out the Committees' decisions.

Cumberland and Westmorland.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers to operate as from May 23 (when the existing rates are due to expire) and to continue until June 4, 1927. The Order continues the present rates unchanged, with the exception that the weekly minimum rate of 38s. per week of customary hours in the case of male workers aged twenty-one years and over will in future apply to workers hired by the month or longer period (instead of only to workers on yearly or half-yearly engagements). The other rates remain unchanged, the rate for other regular male workers of twenty-one and over being 31s. per week of forty-eight hours in winter (November 1 to end of February) and 32s. 6d. per week of fifty-four hours in summer (remainder of the year). In the case of male workers in casual employment the rate for workers aged eighteen years and over is 8d. per hour. The overtime rate for all classes of male workers aged eighteen years and over is 8½d. per hour. In the case of female workers aged eighteen years and over the minimum rate is 5½d. per hour for all time worked.

Dorset.—An Order fixing special rates of wages for male workers for overtime employment during the hay and corn harvests, the rate in the case of workers aged twenty-one years and over being 10d. per hour.

Durham.—An Order to operate for a period of twelve months from May 14 (when the existing rates are due to expire), continuing the existing minimum rates for male workers unchanged, but revising the minimum rates for female workers and the overtime rates for male workers. In the case of workers aged twenty-one years and

over the rates for horsemen are 32s. per week of fifty hours and any additional time spent in attention to horses, with an extra payment of 7s. for workers who are householders, and 3s. 6d. for workers who are not householders and are not boarded and lodged. In the case of stockmen and shepherds the rates are for householders, 43s. per week; for workers who are not householders and who are not boarded and lodged by the employer, 37s. 10½d. per week; and for workers boarded and lodged by the employer, 36s. per week, the rate in each case to cover the hours customarily spent in attention to stock. The rate for other male workers aged twenty-one years and over is 32s. per week of fifty hours. The overtime rates for male workers aged twenty-one years and over are 10d. per hour on Saturday afternoons and on Sunday, and 9d. per hour for other overtime employment. The new rate fixed in the case of female workers aged eighteen years and over is 2s. 6d. per day of eight hours (as against 2s. per day as at present), with overtime at 4d. per hour.

Herefordshire.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates for female workers, to come into operation on May 1 (when the existing rates are due to expire). In the case of bailiffs, waggoners, stockmen, and shepherds aged twenty-one years and over, the rate remains unchanged at 36s. per week not exceeding sixty hours. In the case of other classes of male workers the rates in future will be payable for a week in winter (November to February) of forty-eight hours, and in summer of fifty-two hours, as against fifty-four hours hitherto, the rates in the case of workers aged twenty-one years and over being 31s. per week. The overtime rate for adult male workers is 9d. per hour. In the case of female workers of eighteen years and over the minimum rate is 4½d. per hour for all time worked.

Merioneth and Montgomery.—An Order to operate for a period of twelve months from May 2, continuing the existing minimum and overtime rates for male workers and minimum rates for female workers unchanged. In the case of male workers aged twenty-one years and over employed wholly or mainly as stockmen, teamsters, carters, or shepherds, the rate is 34s. 6d. for a week of sixty hours. In the case of other male workers aged twenty-one years and over, the rate is 31s. 6d. for a week of fifty-four hours, the overtime rate in each case being 9d. per hour. In the case of female workers aged eighteen years and over the minimum rate is 5d. per hour for all time worked.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

Enforcement of Minimum Rates of Wages.—During the month ending April 15, legal proceedings were instituted against eight employers for failure to pay the minimum and overtime rates of wages, fixed by the Orders of the Agricultural Wages Board for workers employed in agriculture.

The particulars of the cases are as follows :—

County	Court	Fines	Costs	Arrears of wages ordered to be paid	No. of workers concerned
		£ s. d.	£ s. d.	£ s. d.	
Cambs ..	Chatteris .	21 0 0	5 2 0	95 12 10	7
Kent ..	Ashford .	20 0 0	—	22 19 3	2
Mont .	Montgomery .	2 0 0	—	21 17 3	1
Somerset .	Wincanton .	5 0 0	0 15 0	24 5 0	3
Lancs ..	Garstang ..	—	1 11 0	9 10 8	2
Cambs .	Woodbridge ..	4 0 0	2 2 6	23 1 7	8
Lancs .	Bamber Bridge	—	3 3 0	19 7 6	3
Hants ..	Lyndhurst ..	5 0 0	0 7 6	34 16 5	1

In the case heard at Ashford on March 23 the employer, in addition to being summoned for paying two workers at less than the minimum rates, was also summoned for molesting the Ministry's inspector in the exercise of his duties, for which offence the Bench fined the defendant £10 with the option of twenty-eight days' imprisonment if the fine was not paid before the defendant left the court.

The Ministry takes a serious view of cases of this kind, and it may be as well to call attention to the fact that the maximum penalty prescribed by the Agricultural Wages (Regulation) Act for such an offence is £20, or imprisonment for a term not exceeding three months, or to both fine and imprisonment, and this penalty is also applicable to any case in which a person refuses to give any information which an inspector may require under the Act, or refuses to produce any document, or gives false information, or produces a document known to be false. Such a case was dealt with at Woodbridge on April 8, when the defendant, in addition to being fined £4 for paying his workers less than the minimum rate, was fined £5 for refusing to give information lawfully required of him by the inspector concerned.

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Foot-and-Mouth Disease.—Since the issue of the April JOURNAL, the following outbreaks of foot-and-mouth disease have been confirmed: Yorkshire, E.R. 16 ; Yorkshire, W.R. 2, and Surrey 1.

New centres of disease were discovered during the month at New Malden (Surrey); Preston, near Hull (Yorks, E.R.), and Royston, near Barnsley (Yorks, W.R.)

Up to and including April 20, the number of outbreaks since January 1, 1926, is 68, involving 14 counties.

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NOTICES OF BOOKS

Agricultural Progress. Vol. III, 1926. (London : Ernest Benn, Ltd., 5s. net.)

Among the items of a general character in this publication there is a very readable first paper by Sir Thomas Middleton upon "The Early Days of the Agricultural Education Association," with which his thirty years' connection entitles him to assume the role of historian. These recollections cover, principally, the first ten years of the Association's existence under the Chairmanship of Brooke-Hunt,

during which "the Association's progress followed the familiar development of the autumn-sown cereal—a promising 'braird,' a resting and rooting period, checks to growth, strong tillering and a rapid filling up and covering of the whole field, the field of agricultural education. Towards this growth," comments Sir Thomas, "went much effort by way of tillage, but there was very little fertilising cash available for purposes of top-dressing!" The Association has long since passed this stage to that of an established and flourishing institution, as this publication testifies, but the story of its early struggles, which Sir Thomas relates with point and humour, will appeal to many outside the Association's own members. One of the earliest of these members was Professor Somerville, a portrait of whom, with an appreciative biographical note, is given to mark the occasion of his retirement from the Sibthorpian Chair of Rural Economy at Oxford.

In the section on "New Developments in Agricultural Education," Dr. Stenhouse Williams gives an outline of the work of the National Institute for Research in Dairying; Professor J. B Buxton has a note on the Institute of Animal Pathology, Cambridge, and the National Poultry Institute Scheme is described by Dr C. Crowther. Descriptions are also given of new university buildings at the School of Agriculture, Cambridge; and of the Departments of Agriculture at the University of Leeds and at University College of North Wales, Bangor. Other items in this section relate to the new dairy buildings at the Reaseheath and Moulton Farm Institute and the Hostel at Sparsholt Farm Institute. Among the notes on Agricultural Scholarships is one by Professor Neville on the United Dairies Scholarship Fund.

Of contributed articles there is one on "Experimental Error," in which it is contended that varying factors, such as the natural differences of soils, holdings and crops, call for a wide extension of experimental investigation, which must, however, be limited by the practical considerations of the time and money involved therein Dr A. G. Ruston deals with "Success in Agriculture and the Methods of its Measurement," in which he finds "little justification for regarding the value of food production, as measured in calories, as an index of the success or efficiency of the farm" In his opinion, "neither a high gross output nor a high social output"—the latter connoting the meeting of the landlord's rent, the workmen's wages and the farmer's profit—are guarantees of financial success, "though both may be of value in judging of the success or failure of farm management if we express them, not only on the acreage basis, but also per unit (*a*) of labour employed, (*b*) of capital invested, (*c*) of total expenditure, and (*d*) of expenditure on the employment of labour"

The first of a series of articles on "Modern Science and Agriculture" is devoted to "Colloids and their Importance in the Soil," by Mr. H. J. Page, of the Rothamsted Experimental Station The two chief colloids in soils are (1) clay, a product of the weathering of silicate rocks, and (2) humic matter, often loosely termed humus, which is organic material derived from the decomposition of plant residues. An explanation of soil colloids, their absorptive power for certain fertilisers, and the reactions involved are given in considerable detail.

There are a number of digests from "Conference Papers" in which dairying matters have a considerable share. This volume fully maintains the scholarship and authority of the previous issues of this interesting and useful Annual.

Agricultural Marketing. J. T. Horner. (London: Chapman & Hall, viii+249, 6×9, 46 figures Price 12s 6d net)

The object of this book, the strong American flavour of which is particularly noticeable in the emphasis placed upon the virtues of

branded products and proprietary articles, is to connect the theory of marketing agricultural products with pure economics, and it is especially achieved in the chapter on "Demand." The discussion on grading and packing, in Chapter III, seems to be adequately treated, considering the scope of the book. In Chapter VII the question of "Selling" is considered in the theoretical light of elementary principles of salesmanship, and seems to suggest a Correspondence Course in that art. The defence of what has often been termed "aggressive selling methods" is argued with conviction on page 112, where it is pointed out that the aggressiveness of salesmen has been responsible for greater economic welfare and increased productivity. The paragraph on Co-operation in the Chapter "Correlation of Supply and Demand" shows that the author, as an economist, has much sympathy with the movement. He says (page 188) that "Co-operation can never control price; it can, however, make the flow of produce to market more orderly . . ." But does not the more orderly flow of produce indirectly control price? The more regular supply surely tends to stabilise the price level, although the other factor, demand, may remain unaltered. The final Chapter is devoted to a discussion of marketing imperfections, and suggestions are given for remedial measures. A useful bibliography, three appendices and an index complete the work. The first appendix consists of thirty questions evidently designed for the student of first principles of marketing economics; the second contains four tables of freight rates for selected agricultural commodities; and the third deals diagrammatically with sources of supplies of corn, oats, wheat and livestock for various cities. It is to be regretted that the diagrams in Appendix C were not enlarged for corn, oats and wheat, and that the proportions of supplies from various origins and travelling various distances were not given. As a whole, the book is very readable; it is amply illustrated and should be a useful guide to the student wishing to link up the problems of agricultural marketing with economic theory.

Practical Fruit Growing. J. W. Morton. (London: Ernest Benn, Ltd. Price 10s. 6d. net.)

Messrs. Ernest Benn, Ltd., have published this book in good form —handy size, good covers and stout, thick paper, whilst the type is bold and plain and can be read without discomfort. The illustrations are well done. The writer—a practical fruitgrower—states his belief that the cultivation of fruit differs from the cultivation of annual crops, because once the land is occupied with fruit, it will remain so occupied for a number of years, for which reason it is necessary to ensure that the soil has in it the material to supply the needs of the fruit trees, and that the land is drained, cleaned, and well cultivated before planting. The methods which, in the experience of the writer, have been practised successfully, are given in a series of chapters. Where the same results have been achieved by following different methods, all are given. The science of fruit growing or the theory of fruit production finds no place in this book. Suitable soils for a fruit plantation are dealt with, together with types which have proved satisfactory, and the lay-out, preparation, and the planting together of mixed types of fruit. The writer recognises the importance of selecting the right stock on which to work the trees, and explains the particular merits of a large number which are mentioned. This chapter could have been much improved by drawing more freely on the results of the research work published by the Research Stations of Long Ashton and East Malling. There is an excellent chapter on spraying, but the writer has omitted to revise the sentence "Winter washes do not kill the eggs of pests." The washes mentioned in the book do not, but what of certain coal tar distillate washes? Surely

entomologists have proclaimed that certain of these do kill eggs. Wrong statements such as these, and omissions of important subjects, detract from the value of an otherwise interesting and useful book.

H. V. T.

Enemies of Timber: Dry Rot and the Death-Watch Beetle. Ernest G. Blake, M.R.S.I. (London: Chapman & Hall, Ltd. Price 12s. 6d. net.)

This is a book of just under 200 pages in largish print, with twenty illustrations, six of which are from half-tone blocks. There are eight chapters, the first four of them dealing with dry rot of timber, and the remainder with the furniture beetle and the death-watch beetle.

In the first chapter the nature of timber and its liability to decay is discussed. A sketch of the development of the wood of a tree is attempted, but the author is evidently no botanist, and the story told is hardly satisfying. Chapter II deals with dry rot due to *Merulius lacrymans* (not *lachrymans*, as the author consistently spells it), and occasionally to *Polyporus vaporarius* and *Coniophora cerebella*. Here again a more attractive account would have been possible at the hands of one versed in mycology.

As would be expected from his qualifications, the author is more happy when he comes to deal, as he does in Chapters III and IV, with the prevention of dry rot in new and its eradication from old buildings. Prevention, in essence, consists in providing for adequate ventilation, and for the absence of dampness, so that the stagnant, humid atmosphere necessary for the development of the fungus cannot exist. Success in eradication depends on the thoroughness with which the removal and destruction of every trace of the rotted wood and of the fungus itself is carried out, and on the subsequent careful disinfection of the affected area. Solutions of corrosive sublimate and carbolic acid are recommended for the latter purpose. Full details are given of the points which must be attended to by the builder when reinstating wood work after an attack, in order to prevent recurrence.

Chapters V to VIII deal with the furniture and death-watch beetles. Descriptions of the biology of these insects, based chiefly upon the work of Dr. Gahan and the late Prof. Lefroy, are given. Perhaps the most interesting chapters are those containing an account of the work of dealing with the death-watch beetle in Westminster Hall, and the formulæ of the various insecticides used for the purpose. This information, which is not readily available in a summarised form, should prove very useful to all those who have to deal with buildings containing valuable old timber.

The book concludes with a good index.

ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Rothamsted Experimental Station.—Library Catalogue of the Printed Books on Agriculture published between 1471 and 1840, with Notes on the Authors by *Mary S. Aslin.* (331 pp. + 22 pl.) Harpenden, 1926, 10s. [016.63 (02).]

U.S. Department of Agriculture.—Dept. Bulletin No. 1379:—Electro-culture (34 pp.), Washington, 1926. [537.]

Ministry of Agriculture and Fisheries.—Report of the Commission on the Ouse Drainage District. (55 pp. + map.) London: H.M. Stationery Office, 1926, 2s. [Cmd. 2572.] [63.14.]

Horticulture and Fruit Growing

Work, Paul.—Tomato Production. (127 pp. + 12 pl.). New York: Orange Judd Publishing Co. London: Kegan Paul, 1926, 7s. 6d. [63.513 (02).]

Scotland, Board of Agriculture.—Miscellaneous Publications No. 5:—Potato Culture in Scotland. Report of Proceedings at Conference held in Edinburgh, August 20 and 21, 1924. (77 pp.) Edinburgh: Board of Agriculture for Scotland, 1925, 1s. [63.512 (04).]

Lindsey (Lincs) County Council Education Committee.—Seed Potatoes: The Influence of the Source of the Seed on the Yield. By *J. G. Murray.* (14 pp.) Lincoln, 1926. [63.512.]

Fairford, F.—Fruit and the Fruit Trade. (154 pp.) London: Pitman & Son, 1926. 6s. [63.41 (02); 63.41 : 38.]

Drain, B. D.—Essentials of Systematic Pomology. (284 pp.) New York: J. Wiley. London: Chapman & Hall, 1925, 13s. 6d. [63.41 (02).]

Farm Pests and Plant Diseases

Claremont, C. L.—A Practical Handbook on Rat Destruction. (190 pp. + 5 pl.) London: John Hart, 1926, 3s. 6d. [63 269 (02).]

Blake, E. G.—The Protection of Buildings Against Vermin. With a Comprehensive Description of the most effective Methods that can be adopted for the Extermination of Rats, Mice, and Various Insects. (95 pp.) London: Crosby Lockwood, 1926, 2s. [69; 63.269; 59.169.]

New York Agricultural Experiment Station.—Bulletin No. 529:—Investigations on the Control of Pear Psylla (*Psylla pyricola* Förster.) (36 pp.) Geneva, 1925. [63.27.]

U.S. Department of Agriculture.—Dept. Circular No. 376:—A Method for the Control of Crown Gall in the Apple Nursery. (8 pp.) Washington, 1926. [63.23]

Poultry

House, C. A.—Ducks: Show and Utility. (113 pp. + 12 pl.) London: The Poultry Press, Ltd., 1926, 2s. 6d. [63.657 (02).]

Texas Agricultural Experiment Station.—Bulletin No. 317:—Comparative Influences of Various Protein Feeds (Tankage, Meat Scrap, and Cotton-seed Meal) on Laying Hens (24 pp.) Brazos County, 1924. [63.651 043.]

Texas Agricultural Experiment Station.—Bulletin No. 331:—The Value of Various Feeds in the Control of Coccidiosis in Chicks. (14 pp.) Brazos County, 1925. [619.5 (*d*); 63 651 (04).]

Economics

Ministry of Agriculture and Fisheries.—Agricultural Policy. (7 pp.) London: H M. Stationery Office, 1926, 2d. [Cmd. 2581.] [338.1 (42).]

Ministry of Agriculture and Fisheries.—Economic Series No. 8:—Report on Agricultural Credit. (104 pp.) London: H.M. Stationery Office, 1926, 1s. 6d. [332.71 (42).]

Ministry of Agriculture and Fisheries.—Economic Series No. 7:—Report on Wool Marketing in England and Wales. (66 pp. + 4 pl.) London: H.M. Stationery Office, 1926, 1s. 6d. [63.761 : 38.]

Horner, J. T.—Agricultural Marketing. (249 pp.) New York: J. Wiley. London: Chapman & Hall, 1925, 12s. 6d. [381 (02).]

Boyle, J. E.—Marketing of Agricultural Products. (479 pp.) New York and London: McGraw-Hill Publishing Co., 1925, 17s. 6d. [381 (02).]

Augé-Laribé, M.—L'Agriculture pendent la Guerre. [Publications de la Dotation Carnegie pour la Paix Internationale; Histoire Economique and Sociale de la Guerre Mondiale. Série Francaise.] (331 pp.) Paris: Les Presses Universitaires de France. London: Oxford University Press, 1926. [63 (44); 338.1 (44).]

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SELECTED CONTENTS OF PERIODICALS

Agriculture, General, and Miscellaneous

Investigations in Agricultural Science at Rothamsted, *Sir E. J. Russell.* (Jour. Roy. Soc. Arts, vol. LXXIV, No. 3824 (Mar. 5, 1926), pp. 346-364.) [37 (072) (42).]

The Drainage of Heavy Land, *H. B. Turner.* (Jour. Farmers' Club, Part 1 (Feb., 1926), pp. 1-16.) [63.14.]

Weeds of Ponds, Water-courses, and Undrained Lands, *J. Percival* and *H. C. Long*. (Jour. Bath & W. & S. Counties Soc., xx (1925-26), pp. 32-53 + 4 pl.) [63.259.]

The Production of Industrial Alcohol from British Vegetable Products, *G. W. Monier-Williams*. (Jour. Farmers' Club, April, 1926, pp. 39-50.) [663.5.]

Field Crops

The Importance of the Sugar Beet, *S. L. Bastin*. (Jour. Bath & W. & S. Counties Soc., xx (1925-26), pp. 1-18.) [63.3433.]

Clovers and Related Crops, *R. G. Stapledon* (Essex County Farmers' Union Yearbook, 1926, pp. 158-165.) [63.33 (*b*).]

Some Studies on the Formation of Permanent Pastures in North Wales, *R. A. Roberts*. (Welsh Jour. Agric., II (January, 1926), pp. 81-102.) [63.33 (*a*).]

The Improvement of Poor Pastures—with Special Reference to the Manuring of Acid Pastures, *T. Wallace*. (Jour. Bath & W. & S. Counties Soc., xx (1925-26), pp. 86-94.) [63.33-16.]

A Study of the Process of Making Stack Silage, *H. E. Woodman and F. Hanley*. (Jour. Agr. Sci., XVI, January 1, 1926, pp. 24-50.) [63. 19832.]

Production of Healthy Stocks of Seed Potatoes, *W. D. Davidson*. (Jour. Dept. Lands and Agr. (Dublin), xxv (1925-26), 3, pp. 281-283.) [63.512; 63.23.]

The Manuring of Maincrop Potatoes, *B. Thomas*. (Jour. Bath & W. & S. Counties Soc., xx (1925-26), pp. 19-30.) [63.512-16.]

Experiments in the Manuring of Swedes in Anglesey, Carnarvonshire, Denbighshire, and Flintshire, 1885-1924, *E. J. Roberts*. (Welsh Jour. Agr., II (January, 1926), pp. 151-159) [63·332-16.]

Plant Pests and Diseases

Fruit Pests and Winter Control Measures, *H. W. Miles*. (Jour. Bath & W. &. S. Counties Soc., xx (1925-26), pp. 53-71 + 10 pl.) [63.27-41.]

Control of Big Bud Mite (*Eriophyes ribis*) in the Field, *R. G. Hatton, J. Amos, and H. M. Tydeman* (Jour. Pomol. & Hort. Sci., v, 2 (March, 1926), pp. 124-130, pl. No. 5.) [63.27.]

The Apple Fruit Moth or "Miner" (*Argyresthia conjugella*, Zeller), *R. S. M'Dougall*. (Scottish Jour. Agr., IX, 1 (January, 1926), pp. 54-61.) [63.27.]

Notes on the Insect Pests of Red Clover, *J. R. W. Jenkins*. (Welsh Jour. Agr., II (1926), pp. 221-228) [63.27-33.]

Leather Jackets and Their Control, *H. W. Thompson*. (Welsh Jour. Agr., II (1926), pp. 228-233.) [63.27.]

Some Experiments on the Control of Bunt of Wheat by Copper Carbonate and other Chemicals, including data on the Growth and Yield of Treated and Untreated Grain, *K. Sampson and D. W. Davies*. (Welsh Jour. Agr., II (1926), pp. 189-212.) [63.24.]

Studies on *Ophiobolus graminis*, Sacc. and the Take-All Disease of Wheat, *R. J. Davis*. (Jour. Agr. Res., XXXI, 9 (November 1, 1925), pp. 801-840.) [63.24.]

The Control of Onion Smut (*Urocystis cepulæ*), *N. L. Alcock, A. E. S. M'Intosh, and G. B. Wallace*. (Scottish Jour. Agr., IX, 1 (January, 1926), pp. 65-70.) [63.24.]

The Control of Leaf-Roll Disease in Potatoes by the Diagnosis of "Primary Infected" Tubers, *W. McLean*. (Jour. Agr. Sci., XVI, 1 (January, 1926), pp. 149-157.) [63.23.]

Some Fungus Diseases of Fruit Trees, *S. A. Murphy*. (Jour. Dept. Lands and Agr. (Dublin), xxv (1925-26), 3, pp. 269-280 + 2 pl.) [63.24-41.]

Silver Leaf Disease (*Stereum purpureum*) V, *F. T. Brooks and W. C. Moore*. (Jour. Pomol & Hort. Sci., v, 2 (March, 1926), pp. 61-97.) [63.24.]

The Winter Spraying of Fruit Trees. Tests with the New Tar Oil Washes, *O. Sherrard*. (Jour. Dept. Lands & Agr. (Dublin), xxv (1925-26), 3, pp. 297-304.) [63.295.]

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NOTES FOR THE MONTH

The Marketing of Potatoes

A STRICT surveillance has been kept on the diseases and pests of the potato, and growers have gone far to improve its quality by a high standard of selection and cultivation, but these achievements have not been paralleled by a high standard of marketing organisation. This fact emerges from a study of the Ministry's Report* on the Marketing of Potatoes in England and Wales which has just been published.

The Report analyses the movement of potatoes from grower to consumer and gives a description of the services which are utilised at each stage of the process. The functions of various types of distributors, the part played by the different kinds of markets, and the incidence and extent of marketing costs are discussed in detail. Consideration is also given to the different aspects of commercial grading and standardisation, the problems of packing, transportation, and storage. Growers of "seed" potatoes will find much useful information in the Report to assist them in a trade which is becoming increasingly specialised.

Most of the suggestions seem to require consideration by a body of growers and merchants acting in the interests of the potato trade as a whole. One of the most important is that of the casual surplus. A widely fluctuating crop yield is characteristic of potato production; with demand relatively inelastic, it follows that, from time to time, a more or less unmarketable surplus results. These years of plenty usually spell disaster to many growers who may find access to a drugged and sluggish market a difficult matter and prices

* *The Marketing of Potatoes in England and Wales* (Economic Series, No. 9). Obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. Price, 1s. 6d. net.

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out of all relation to costs of production. To aid in stabilising the industry in these years of crisis, suggestions are made in the Report which merit the serious consideration of all concerned. The proposal that a Potato Stabilisation Fund should be built up by the industry itself on a contributory basis and should be applied directly in years of surplus to facilitate the flow of supplies into exceptional channels is of far-reaching importance and derives added significance from the attention now being given by American farmers to the same problem.

A Report of this nature is needed by the industry; much of the material has not been published before, and growers, grower-merchants, wholesalers, commission salesmen, retailers, and consumers alike would be well advised to make themselves acquainted with its contents.

World Agricultural Census

AT the General Assembly of the International Institute of Agriculture which opened on April 19 last, considerable progress was made towards the realisation of the project put forward by the Institute for the holding of a World Agricultural Census in 1930-31. This proposal was first officially enunciated at the General Assembly of 1924, when a resolution was passed emphasising the great importance of the idea and instructing the Permanent Committee of the Institute to take the necessary steps to secure the collaboration of adhering countries and to prepare a programme for submission to a Committee of statistical experts who would consider the question at the General Assembly of 1926. Steps were at once taken to sound the various Governments by means of a circular letter from the Institute and nearly all the replies were favourable on the main question as to the desirability of taking such a census, and the willingness of the adhering countries to co-operate.

In the meantime the preparatory work was put in hand and a special bureau instituted for the World Agricultural Census. This office was financed partly from the ordinary funds of the Institute but in the main from an annual contribution of 10,000 dollars a year for five years by the "International Education Board" (Rockefeller Foundation). The work of direction was entrusted to Mr. Leon Estabrook of the United States Department of Agriculture, assisted by his own staff, subject always to the control of the Statistical Bureau of the Institute.

In February last the Institute summoned to Rome a few specially chosen statisticians to consider and amend the first draft of the form prepared by Mr. Estabrook and to report on it to the Committee of Statistical Experts which was summoned to meet in the week preceding the General Assembly. Both these Committees met and made substantial amendments in the form, all of them designed to secure greater brevity and simplicity. The form as revised was adopted by the General Assembly without amendment, and it is now proposed to circulate the form, together with suitable explanatory notes, to the Governments and to take such steps as may be considered desirable with a view of inducing all the countries of the world to agree to take an agricultural census on the lines indicated.

The actual form which it is proposed to circulate is confined to questions relating to the area of crops harvested, the number of live stock, and the labour employed. All such questions have to be answered directly by the farmer and can in fact be answered without difficulty. There is, however, attached to the form an appendix consisting of questions dealing with the production of crops, milk, wool, honey, silk, &c. These questions are of primary importance, but it is proposed that the method of obtaining such information, *i.e.*, either by direct inquiry from the farmer or by expert estimation, should be left to the direction of each country.

There are in addition a number of supplementary questions on which it is desirable, though not essential, that as many countries as possible should supply information ; among them may be instanced the various forms of tenure, drainage and irrigation, wages and housing of labour, the variety and amount of fertilisers used, stocks of the chief agricultural products on farms at a given date, the production of glasshouse and nursery produce, the use of agricultural machinery, etc. So far as the northern hemisphere is concerned the census is to apply to the crop areas harvested and the quantity of products obtained in the calendar year 1929, and as regards the southern hemisphere in the twelve months July 31, 1929, to June 30, 1930. The fixing of a date or dates on which the information relating to the numbers of live stock and the labour employed should be collected presents great difficulties, and this question was left in abeyance for the time being.

It must be realised that the form, as it stands at present, is purely provisional, and that without doubt many suggestions and amendments will be put forward by the various

governments and by the Bureau of the World Census before the meeting of the next General Assembly in 1928, when the final form will be settled. In addition the final form is intended only as a guide for all the countries taking the census, and that each country should be free to introduce modifications applicable to its own peculiar conditions and to include in the form such additional questions as may seem desirable. At the same time the questions contained in the provisional form have been so simplified and have secured such a general measure of acceptance as the basis of the final form that there is every reason to hope that when the time comes the countries concerned will find themselves in a position to secure comparable information on all essential points.

Annual Returns of Crops and Live Stock under Agricultural Returns Act, 1925

THE annual agricultural returns, which are collected each year on June 4, are now compulsory under the provisions of the Agricultural Returns Act passed last year. Every occupier of more than one acre of agricultural land, which includes orchard land, market gardens and nurseries, is required to make a return. The forms for the returns will be issued immediately before June 4, and when completed they should be forwarded to the Crop Reporter whose address appears on the back of the form. It is hoped that all occupiers will make their returns promptly so that the tabulated results may be published as early as possible.

The Act provides that no individual return or part of a return may be used, published or disclosed except for the purposes of the preparation and publication of agricultural statistics or of a prosecution under the Agricultural Returns Act.

Foot-and-Mouth Disease

IN his address to the Council of Agriculture for England,* on June 1, the Right Hon. Walter Guinness, M.P., Minister of Agriculture and Fisheries, referred to the question of foot-and-mouth disease in the following terms:—

" Foot-and-mouth disease has given us

* A report of the Meeting of the Council of Agriculture will appear in the July issue of this JOURNAL.

a great deal of concern. In March and April we had some serious outbreaks in East Yorks. It is a district where large numbers of cattle and sheep are wintered, and the position became very serious owing to lack of feed. The hardship on the farmers was very great because a lot of the stock was ready for market, and under the necessary restrictions which had to be imposed large losses were inevitable. I am glad to say that the local farmers played up in a very efficient way, and with the assistance of the National Farmers' Union they set up a temporary co-operative abattoir which enabled them largely to decrease the losses which they suffered. The number of outbreaks in the last month—May—was 18 ; in April it was 10 ; in March it was 19. In the last ten days we have had a new and unfortunate development. Scotland, which had been free from foot-and-mouth disease for over two years, has now become a centre of a new outbreak, and in connection with this outbreak we have made a very important discovery, that the origin is traceable to foreign pigs brought in for curing at a British bacon factory. There have been seven outbreaks in the vicinity of the bacon factory at Carluke, and they are all traced to virulently infected carcasses which had been brought in from Holland and Belgium. The carcasses in some cases have been Dutch, in other cases they have been Belgian, but they have all come, I think, through Holland. The infected carcasses came from Belgium, but they came through Rotterdam. Apart from the carcasses at Carluke, we have now got another case of foreign infection through Carlisle, and a shipload, including infected carcasses, has arrived at Leith. We have long suspected that foot-and-mouth disease might be brought to this country by foreign meat, and especially offals, which obviously are an extremely dangerous source of infection, being full of blood, which, as you know, is the most dangerous medium. For the first time we have got absolutely definite and complete evidence, and now that we have been able to get on to it—because it must be remembered that we have no machinery in the ordinary course under the Ministry of Agriculture for inspecting meat cargoes at the port—now that we have got on to it, and traced it back from the outbreak, I think it is absolutely imperative that we should take action to minimise this risk. At the same time I am sure the Council will understand that this matter raises issues of great importance, and I cannot give any indication of what action we may take until I have consulted the Government as a

whole, as in a matter of this grave importance which affects foreign countries as well as ourselves, I must get the approval of my colleagues to any action which we may take. However, I can assure you that no time will be lost. We have only just got the necessary evidence, because it takes some time to trace these cases back, and we shall act on it I hope at the earliest possible moment."

The Agricultural Index Number

THE general level of prices of agricultural produce in April was 53 per cent. higher than in the corresponding month of 1911-13, an increase of 3 points as compared with the March figure. This increase was mainly due to the fact that the price of milk forwarded to London and Birmingham districts under the terms of the National Farmers' Union contracts was only 1d. per gallon below the winter price, whereas in previous years the April price was similar to that paid throughout the summer. Prices of agricultural produce, on the average, were at practically the same level as in April, 1923 and 1924, but were 5 points lower than in April, 1925.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921:—

Month	Percentage increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	183	75	68	61	70	58
February	167	79	63	61	67	53
March	150	77	59	57	65	50
April	149	70	54	53	58	53
May	119	71	54	56	57	—
June	112	68	51	58	55	—
July	112	72	53	52	51	—
August	131	67	54	59	56	—
September	116	57	56	60	57	—
October	86	59	51	63	53	—
November	79	62	53	64	53	—
December	76	59	56	63	53	—

Grain.—Wheat advanced in price throughout the month and averaged 11s. 11d. per cwt. as compared with 11s. 6d. in March, the former figure being 57 per cent. higher than in the base years. Barley averaged 9s. 1d. and oats 8s. 11d. per cwt., these prices being in each case 1d. per cwt. above

those of March. The index figure for barley rose by 4 points to 18 per cent., and that of oats by 1 point to 26 per cent. above pre-war. All classes of grain sold at lower prices than in April, 1925, wheat being 4d., barley 1s. 6d., and oats 7d. per cwt. cheaper than a year earlier.

Live Stock.—Fat cattle were slightly dearer on the month, but as the increase was relatively less than in pre-war years, the index figure shows a drop of 4 points to only 39 per cent. above pre-war, or the lowest index number since the war, and 11 points lower than in April, 1925. The average price of fat sheep was ¼d. per lb. higher than in March, and as a reduction occurred as between March and April, 1911-13, the index number rose from 52 to 59 per cent. above pre-war. Bacon pigs were 2d. and porkers 4d. per 14 lb. stone cheaper on the month, but at 82 and 84 per cent. respectively above 1911-13 prices were relatively very dear as compared with other agricultural commodities. Prices of all classes of store stock were at a higher level than in March, dairy cattle being 5s. and store cattle 12s. per head dearer, while store sheep averaged about 2s. 6d. per head more. Both fat and store cattle and sheep were cheaper than a year earlier, but pigs, especially stores, were much dearer.

Dairy and Poultry Produce.—The average price of milk in the Manchester area was reduced on the month from 1s. 6d. to 1s. 0½d. per gallon, while in the London and Birmingham districts prices under contracts made in accordance with the National Farmers' Union scheme only fell from 1s. 5d. to 1s. 4d. per gallon. A fair proportion of milk sent by producers whose earlier contracts did not cover April was sold at lower rates than those fixed under the National Farmers' Union scheme, but on the average the April price showed a much smaller reduction than usual as compared with the previous month, and the index figure records an advance of 23 points, milk being nearly twice as dear as in April, 1911-13. Butter was 1d. per lb. cheaper on the month, but as the reduction was relatively less than in the basic years the index number rose from 46 to 49 per cent. above pre-war, while cheese was unchanged at 77 per cent. above. Eggs averaged ¾d. per dozen less than in March and sold at 48 per cent. more than in the corresponding month of 1911-13. As compared with April, 1925, eggs and butter were cheaper, but cheese was about 10 per cent. dearer.

Other Commodities.—The decline in potato prices was continued, and average prices were about 5s. per ton lower

than in March. Potatoes were only 7 per cent. dearer than in the basic years and were 50 per cent. cheaper than in April, 1925. Cabbage sold at higher figures than in March and was twice as dear as in pre-war years. Cauliflowers also made double 1911-13 prices, while carrots were relatively very dear at 140 per cent. above their price in the basic years. Hay was unchanged on the month and was relatively the cheapest of all agricultural produce, being only 5 per cent. dearer than in April, 1911-13.

Index numbers of different commodities during recent months and in April, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	April	April	Jan.	Feb.	Mar.	April
Wheat	38	62	67	60	55	57
Barley	48	38	31	19	14	18
Oats	35	34	35	27	25	26
Fat cattle	49	50	52	47	43	39
Fat sheep	75	100	63	50	52	59
Bacon pigs	30	68	94	89	85	82
Pork pigs	39	67	94	89	89	84
Dairy cows	63	47	42	40	37	39
Store cattle	38	39	33	37	31	31
Store sheep	84	100	57	53	61	60
Store pigs	42	55	121	121	115	119
Eggs	48	51	70	72	41	48
Poultry	70	50	56	50	50	46
Milk	58	58	74	74	72	95
Butter	51	64	53	47	46	49
Cheese	71	61	82	78	77	77
Potatoes	154	115	53	49	31	7
Hay	0	—2*	4	4	6	5

* Decrease.

THE INTERNATIONAL INSTITUTE OF AGRICULTURE

THE General Assembly of the International Institute of Agriculture was held at Rome from April 19 to 26, 1926, and was attended by about 152 delegates representing sixty-two countries (including colonies), and also by a number of "observers." The British delegation consisted of Sir Daniel Hall and Mr. R. J. Thompson, representing the Ministry of Agriculture, together with Mr. R. R. Robbins of the National Farmers' Union. Sir Robert Grieg and Mr. J. R. Ramsay represented the Board of Agriculture for Scotland, and Dr. Scott Robertson the Ministry of Agriculture for Northern Ireland; Sir Daniel Hall and Mr. Thompson also represented Australia and New Zealand.

The opening meeting, at which the King of Italy was present, was addressed by the Prime Minister, Signor Mussolini. Sir Daniel Hall replied on behalf of the British Empire.

The following is a brief summary of some of the matters which came up for discussion:—

Finance.—One difficulty with which the Institute has been faced in recent years has been the insufficiency of the funds placed at its disposal, owing primarily to the depreciation in the value of the lire. The budget voted for 1925 and 1926 amounted to 3,900,000 lire as compared with a budget figure in 1914 of 1,190,000 lire. The value of the lira, however, in 1926 was only about one-fifth of what it was in 1914; thus with the exchange at par, as it was then, the income provided in 1914 was equivalent in sterling to £47,600 per annum, whereas with the exchange at 120 the income provided in 1926 was only equivalent to £32,500 gold. Moreover, the index number of wholesale commodity prices in Italy is seven times what it was before the war, so that the purchasing power of the lira has really decreased to a greater extent than is indicated by the alteration in the rate of exchange.

In accordance with the agreement reached at the previous General Assembly, a new system of contribution comes into operation as from January 1, 1927, whereby the total net expenditure budgeted for by the institute (calculated in Italian lire) is divided among the adhering countries according to the number of units of subscriptions which each country has undertaken to pay, subject to a maximum limit of 4,000 gold francs per unit.

In the original Convention of 1905 the value of the unit of subscription was fixed at 2,500 francs, and the present General Assembly, in fixing the unit of subscription for the years 1927 and 1928, felt that it was not desirable to exceed this figure of 12,500 Italian lire, this being approximately the equivalent of 2,500 francs at par or on a gold basis. It was recognised that this would not fully provide the funds required by the Institute, but, having regard to the universal restriction in expenditure, there was a risk that certain countries might feel disinclined to accept the new system if it at once made them liable for something materially more than was provided for in the original treaty.

On the basis of a unit of subscription of 12,500 lire, the total expenditure was accordingly fixed at 5,260,000 lire (£43,800) for each of the years 1927 and 1928, but in addition certain non-recurring charges in 1926-27-28 amounting in the three years to 1,838,000 lire (£15,000) are to be paid from the reserve fund. Calculated in sterling, therefore, the authorised expenditure of the Institute for the next two years is approximately the same as in 1914.

The financial stress which presses upon the Institute is the necessity of increasing the salaries of the staff, which are now so low, having regard to the cost of living, as to make it difficult to fill vacancies or to retain capable men. Some provision has been made in the budget for temporary increases, but fundamentally the whole future of the Institute rests on the provision of more money by the adhering Governments on a scale which will enable it to employ a larger staff, and also enable it to attract more capable and competent men. In proportion to the funds at its disposal, however, the Institute is doing valuable work, and in most cases is relieving countries of expenditure which they would have to incur individually if it were not being done by the Institute for the joint benefit of all. The staff, notwithstanding the inadequate salaries, appears very keen and generally efficient.

Three developments of importance were discussed at the General Assembly, viz. :—

(1) The establishment of a Scientific Council.

(2) The development of relations with Agricultural Associations, and

(3) The establishment of a Colonial Bureau.

The Scientific Council.—It has long been felt that the Institute needed some arrangement for obtaining scientific

and technical advice, over and above that provided by certain members of the Permanent Committee, and the President recently decided to set up a Scientific Council divided into numerous committees, the members of which would be available to advise the Institute on special subjects either by correspondence or by conference at Rome. There can be no doubt in principle of the soundness of this proposal, but it was decided that the Governments should be consulted as to the men to be chosen.

Relations with Agricultural Associations.—The General Assembly of 1924 indicated the desirability of establishing some system which would bring the Institute into closer contact with Agricultural Associations, and with this object a scheme has been devised under which the principal Associations of the different countries are invited to nominate representatives to assist the Institute in a consultative capacity. Some further experience of this proposal is necessary before it is possible to express any opinion, but obviously it is a method which should help to bring the Institute into closer touch with Associations. It is difficult, however, to make it effective in the case of distant countries, or countries where the number of organisations is very large. It appears to have been the view of the President that this consultative body, being of an international character, ought to render unnecessary any other international organisation of Agricultural Associations, such as has been proposed by Mr. Laur of the Swiss Peasants' Union, or such as already existed in the International Commission of Agriculture, an old-established organisation with its headquarters in Paris. This view was not pressed, however, and the International Commission, with an amended constitution, will now endeavour to form itself into a free and independent federation of Agricultural Associations, while at the same time maintaining a close liaison with the Institute at Rome.

Extension of the Colonial Work of the Institute.—A decision of interest to the colonies was that to establish in the Institute a new bureau definitely entrusted with the duty of studying and publishing information as to colonial and tropical agriculture. For several years past the extension of this side of the Institute's work has been advocated, and some attention had been given to the subject, but on this occasion there was a consensus of opinion in the Assembly that more definite action must be taken, and an additional sum of 500,000 lire was voted to defray the expenses of a separate bureau. It is

hoped that the Institute will be able to do some effective work in this direction, and that as a result the Governments interested in the subject will find themselves able to increase their contributions to enable the Bureau to become effective.

Statistics.—The part of the Institute's work which is perhaps most genèrally appreciated is that of the Statistical Bureau, and various recommendations were made by the General Assembly tending to its extension and enlargement. The President in his report also made some interesting suggestions as to the development of the statistical work in order to make it of more direct utility and value.

The most important statistical question which came before the General Assembly was that of the preparations for the World Agricultural Census in 1930, in regard to which a separate note is published on page 194. In view of the importance of increasing our knowledge as to the world supply of food and other agricultural products, it may fairly be said that the effort which the Institute is making to obtain a universal census on a uniform basis is an international work of real utility. Apart from the stimulus to collect the desired information, it is hoped to supply the Government statisticians throughout the world with a mass of information as to the technical aspects of collection and tabulation of data, and as to methods of estimating which can be adopted in cases where direct information cannot be obtained.

Work of the Bureau of Agricultural Science.—The technical work of the Institute in the past has been mainly confined to the collation and publication of summaries of scientific and technical information, and it is understood that this kind of work is of considerable value to countries which do not possess any very advanced organisation for agricultural education and research. Apart from this an effort has recently been made to develop international action in regard to plant protection and similar questions. At a meeting of experts held in the week before the Assembly a scheme for an International Convention for Plant Protection had been drafted, and recommendations were made as to the publication of a list of plant diseases and pests in different parts of the world, and of a monthly bulletin summarising current information likely to be of value to phytopathologists and plant protection services in different countries. The general utility of these proposals is admitted, the only question being whether the Institute with its present resources is really in a position to undertake this additional task in an efficient manner.

Work of the Economic Bureau.—The General Assembly was impressed with the desirability of developing the economic work of the Institute, and made recommendations as to the preparation of schemes of inquiry as to the marketing of agricultural produce and as to the economic agricultural conditions in different countries. Both these recommendations are of a very generalised character and will need consideration. The President in his report laid a good deal of emphasis on the importance of the Institute taking a much greater share in the discussion of international economic and social questions, and given a competent staff there is a useful field of activity in this direction.

Library.—The library of the Institute now consists of some 160,000 volumes, and may claim to be one of the largest agricultural libraries in the world. A grant to provide the services of a highly trained librarian has been made by the International Education Board, which is also paying the cost of giving a three years' training to three assistant librarians in order to provide the Institute with a nucleus trained staff.

THE USE OF THE AEROPLANE FOR APPLYING INSECTICIDES

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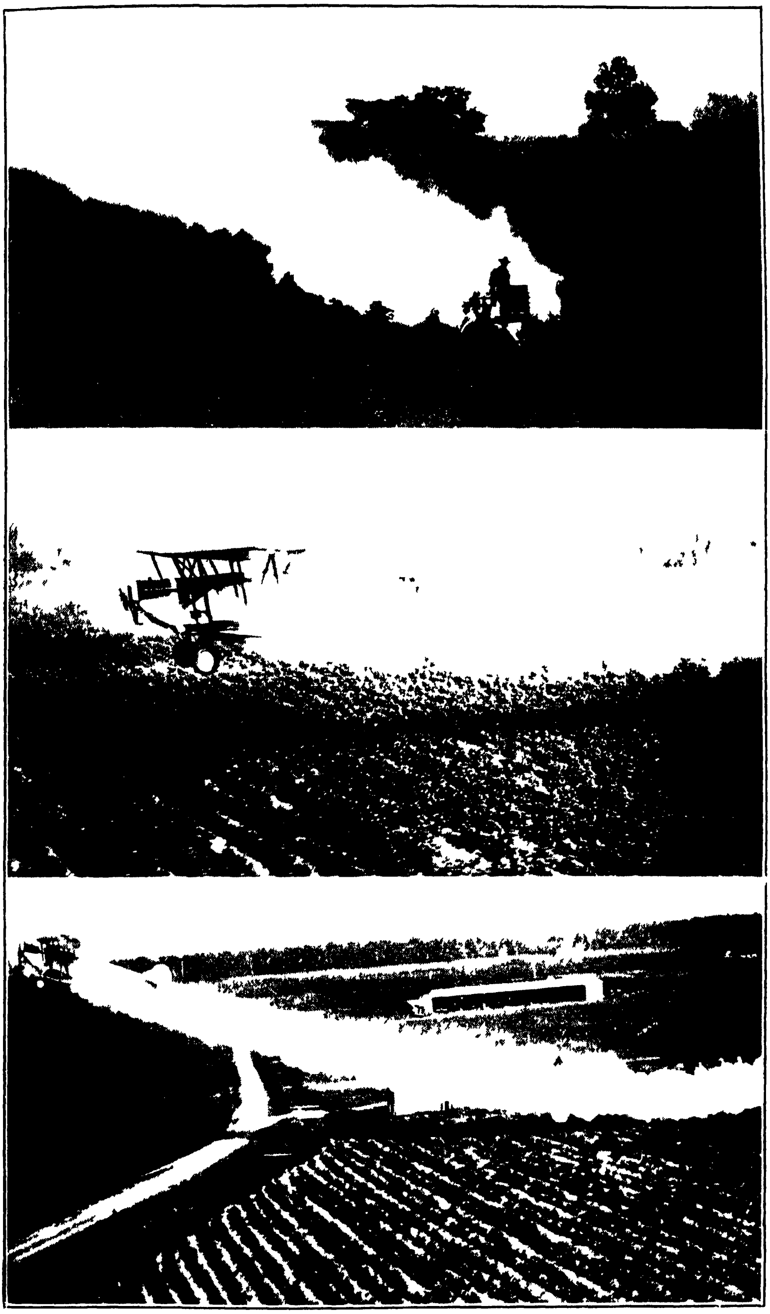
THE use of the aeroplane for the application of insecticides by means of dusting is the newest method of combating injurious insects. The following article is written with the object of tracing the development of this venture and summarising its position at the present day. During the spring of 1925, the writer visited the Delta Laboratory, for Cotton Boll Weevil investigations, at Tallulah, Louisiana. While there he had the pleasure of discussing some of the technical problems with Dr. B. R. Coad, who is in charge, as well as witnessing a demonstration flight in the use of the aeroplane for dusting purposes. A journey of about 45 miles was also taken in an aeroplane over territory where dusting operations had been carried out on a moderately large scale (Figs. 1 and 2).

The possibility of applying insecticides by means of aeroplanes was first investigated in August, 1921, when the Ohio State Experiment Station conducted a series of trials with lead arsenate. The tests consisted in distributing the poison from an aeroplane over a grove of catalpa trees which were

being defoliated by the larvae of the catalpa sphinx moth (*Ceratomia catalpae* Bdv.), and the success achieved in this experiment suggested the use of the aeroplane to combat the cotton boll weevil (*Anthonomus grandis* Boh.) At the request of Dr. B. R. Coad, arrangements were made by the U.S. Department of Agriculture for a series of trials to be carried out the following year at the Delta Laboratory, Tallulah, La. Since the cotton leaf worm (*Alabama argillacea* Hübn.) was, at the time of the experiments, causing severe damage in the vicinity of Tallulah this insect was made the subject of these trials. It was also apparent that the effects of the treatment on a leaf-feeding insect would be more immediate and easier to estimate for purposes of a preliminary trial than on the cotton boll weevil. In these experiments calcium arsenate was used and the results achieved showed that the cotton leaf worm could be controlled with a poison allowance considerably below that necessary when using ordinary dusting machines on the ground. During 1923 boll weevil control with aeroplanes was undertaken on two entire plantations covering about 3,000 acres. The net result of the experiment showed that the aeroplane can distribute an insecticide efficiently, effectively and profitably for the control of the cotton boll weevil. During 1925, over 50,000 acres of cotton were dusted commercially, and plans are in preparation for a more extended application of dusting from aeroplanes in the future. While this method is naturally undergoing development and modifications in technique, its advantages have now definitely passed the preliminary experimental stage. It is noteworthy that spruce, pecan, tobacco, peaches and citrus fruits, in addition to catalpa and cotton, have been dusted from the air. Experiments also in poisoning *Anopheles* larvae with paris green delivered from aeroplanes, in the lakes and bayous of Louisiana, have reached a point when appropriations are being considered with the object of adopting this method for extensive control. The same method has been tested with reference to the control of mosquito larvae in flooded rice fields which proved well adapted for successful treatment by aeroplane.

In so far as cotton dusting is concerned, the aeroplanes fly from 10 to 20 ft. above the growing crop and at a speed of 60 to 80 or more miles per hour. Under ordinary conditions it is not necessary to distribute more than 2 to 3 lb. of the arsenical per acre in order to obtain satisfactory weevil control. At first, military aeroplanes were used for this work, but were found unsuitable. Under average conditions two methods of



(Photographs by courtesy of the Bureau of Entomology, U.S. Department of Agriculture.)

FIG. 1. DUSTING OPERATIONS. *Top*, Ground Dusting Machine at work. *Centre*, Dusting Aeroplane in Operation. *Bottom*, Termination of Dusting a Field Strip: the aeroplane is rising before turning, the dust cloud is cut off, and the propeller blast forces it back on to the cotton rows.

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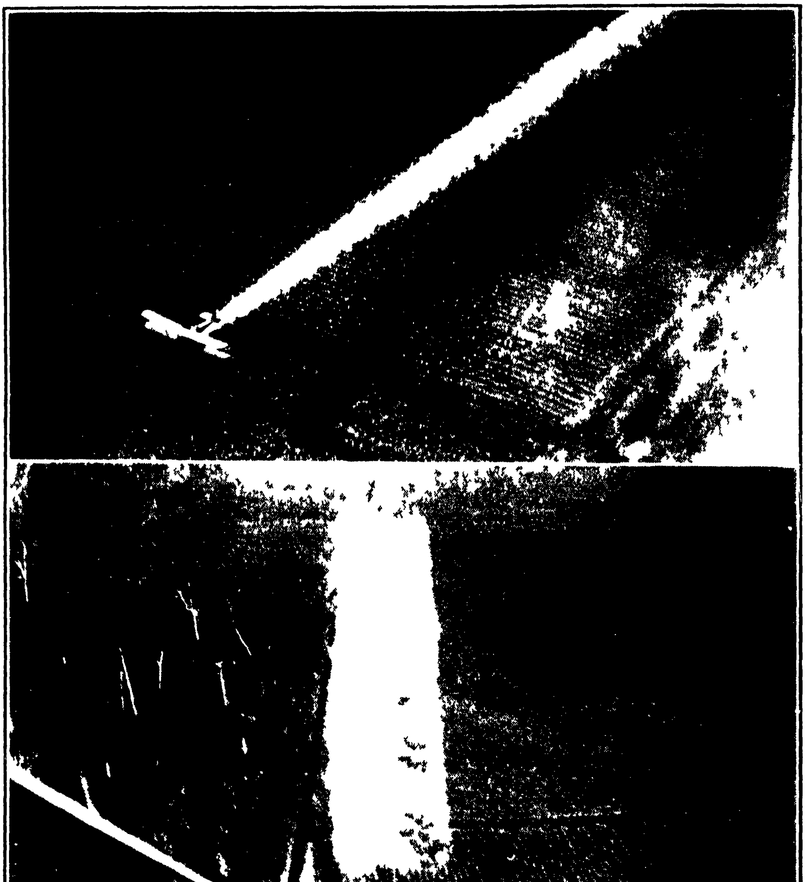

(Photographs by courtesy of the Bureau of Entomology, U. S. Department of Agriculture.)

FIG. 2.—DUSTING OPERATIONS. *Top*, Dusting Aeroplane in "straight away" Flight over Cotton Field. *Centre*, View Taken Above a Dust Cloud Laid by an Aeroplane. *Bottom*, Dusting a Narrow Lake against Mosquito Larvae in the Mississippi Delta.

flying need to be adopted: the long straight-away flights over extensive fields, and the short flights involving quick turns which are required in restricted areas. Aeroplane builders turned their attention to the subject and the outcome of experimental work has been the production of special planes which are safer and more efficient for dusting purposes than are military machines. The Huff-Daland Model 5 is a new machine and is recommended by the U.S. Department of Agriculture for the small-field type of work on account of its diminutive size, manœuvring capacity and ease of control. It has a calcium arsenate capacity of 300 lb., carries fuel and oil for a four hours' flight, and is capable of dusting 300-400 acres per hour. The Huff-Daland Model 31 was designed and constructed to specification of the U.S. Department of Agriculture to meet the requirements of dusting large open areas. It has a calcium arsenate capacity of 1,000 lb. fuel and oil for four hours, and can dust 600–1,000 acres per hour. It is assumed that 80 per cent. of the average cotton fields can be dusted with Model 5, and, at an average of 360 acres per hour, a day's flight of four hours will be capable of treating 1,440 acres.

The advantages of aeroplane dusting are stated by Mr. G. B. Post, of the Georgia State College of Agriculture, to be as follows: (1) It saves 50 per cent. to 60 per cent. of the calcium arsenate required to produce the same results by any other method of dusting. (2) Unlike ground dusting it is not necessary that it should be carried out at night, and the usual dry winds are not a hindrance. (3) One aeroplane will carry out the work of 50–75 cart dusting machines, as the best cart machine, under favourable conditions, dusts about 30 acres *a day* compared with 200–1,000 acres *per hour* by a single aeroplane. (4) The possibilities of the aeroplane are limited only by its capacity for carrying fuel, oil and the dusting material. According to figures compiled by the Louisiana State University, May, 1924, the average cost of five dustings was \$7·26 per acre (approximately £1 10s.) and the dusted fields yielded an average clear net gain of \$33·14 per acre (approximately £6 16s. 6d.: at 11 cents per lb. of seed cotton) over fields that were not dusted.

Two chief types of hoppers have been designed, and for the discharge of the dust a valve is opened and the dust liberated either by means of a kind of paddle wheel worked by hand or by air suction. More recently various other devices for distributing the poison from the aeroplane have been developed and perfected.

One of the most remarkable results of aeroplane dusting is the large amount of poison which adheres to the plants over a very wide path, and even under atmospheric conditions which would be considered impossible for adherence to occur with the use of the best of existing ground dusting machines. This fact immediately demanded research since it indicated the possibility of all types of dusting taking place during daytime. It appears probable that a considerable portion of the observed effect is due to the positive electrical charging of particles of the dust and their coming in contact with the plants which carry a negative charge. The principles involved and their possible application to commercial operations are being investigated in co-operation with the Bureau of Public Roads and the Bureau of Standards.*

Finally, it may be added that no farmer can afford to maintain aeroplanes and carry out his own dusting. In fact the operation can only be considered on a community basis or as one for large planters. The Huff-Daland Co., however, have established an aeroplane service, and are able to do the work at specific charges in certain districts where farmers most demand it.

The application of the aeroplane for forest pest control is now an accomplished fact in German forestry practice, and the subject has recently been reviewed by Wolff and Krausse (1925), who quote instances where it has been carried out. Krieg (1925) refers to a severe outbreak of the pine moth (*Panolis flammea*) in Germany in 1924, which was followed early in 1925 by an infestation of the nun moth (*Lymantria monacha*). As this threatened to be of serious proportions, opportunity was taken to dust the infested area of forest with calcium arsenate discharged from aeroplanes. Flying at a height of 12 to 60 ft. above the tops of the trees, an aeroplane dusted a strip about 80 to 120 yards wide. A forest of about 600 acres, composed of mixed trees, required thirty-eight such strips and, in the case of spruce, the calcium arsenate expenditure amounted to about 26 lb. per acre. Since the nun moth larva is comparatively resistant to insecticides, the expenditure of calcium arsenate could be reduced for other insect pests. Subsequent examinations showed that all the nun moth larvæ were killed in five

* New types of ground dusting machines have been constructed, with special reference to certain of the new principles brought to light through aeroplane operation. What promises to be one of the most efficient dusting machines so far evolved has passed through much of the experimental stage, and it is hoped that it will prove to be the first satisfactory day-light dusting machine. This would abolish the necessity of having the plants wet with dew, thereby eliminating night dusting as is required under present methods.

to six days, and it is stated that no injurious effects were observed on game or birds. The aeroplane has been used for forest scouting and patrol work in Canada and, after problems relative to expense and safety of operations have been solved, probably only a short period will elapse before it will be utilised for dusting purposes in that country also. In North and South Africa and other countries where locust invasions are prevalent, the aeroplane is destined to form the most formidable weapon for controlling these plagues. No other means can compete with it in such cases where prompt and energetic action is demanded at short notice and extensive areas of country are concerned. It may be added that large scale dusting experiments by the use of aeroplanes were carried out in Russian Turkestan in 1924 for the control of locusts. Korotkikh has recently given a brief account of a series of trials carried out in 1925 by the Russian Commissariat of Agriculture, in conjunction with the Air Force, in the extensive reed beds of the river Kuma in the Northern Caucasus. The experiments were directed against the European migratory locust, *Locusta migratoria* L., and the trials are stated to have been very satisfactory, about 2,700 acres being dusted. One aeroplane covered 270 acres in an hour, but, with technical improvements, it is considered that this figure is capable of considerable increase. The application of paris green or sodium arsenate as dusts compared favourably with spraying with about the same quantity of the toxic agent per acre. The method proved most effective against the "hopper" stage of the insect: dusting the resting swarms of adults was also possible but needed to be carried out in the early morning before such swarms became disturbed and dispersed. It is mentioned that the dusting operations were accompanied by certain poisoning effects upon the men employed, and the airmen had to wear respirators. These disadvantages are not reported in trials carried out in other countries, but it is not possible to say to what extent thay may be avoidable under the conditions applicable to the Russian experiments.

In England there are comparatively few large areas devoted to single crop cultivation, and the possible application of the aeroplane is necessarily limited. Nevertheless, it seems likely that the method has chances of development in the future, particularly if inventions lead to the evolution of planes capable of landing and operating in limited areas. In 1924, fifty acres of fruit trees on a farm near Sevenoaks were dusted against caterpillar infestation. It has not been possible, however, to

obtain reliable details with respect to the methods employed or the success of the venture.

LITERATURE REFERRED TO.

(1) COAD, B. R., JOHNSON, E., and MCNEIL, G. L., 1924.—Dusting Cotton from Airplanes. *Bull.* 1204., *U.S. Dept. of Agriculture.*

(2) HOUSER, J. S., 1923.—Dusting Tall Trees by Airplane for Leaf Eating Insects. *Journ. Econ. Entom.*, 16, No. 3.

(3) HOWARD, L. O., 1924, 1925.—Reports of the Entomologist. *Annual Reports U.S. Dept. of Agriculture.*

(4) KOROTKIKH, A., 1925.—On a New Front (In Russian.) *Samolet* (Aircraft) II, No. 9, (23) pp. 37-38, 5 figs. Moscow. (Quoted from *Review App. Entom.* Ser. 4, 1926, p. 30).

(5) KRIEG, 1925.—Die Bekampfung forstlicher Schädlinge durch Abwurf von Calziumarseniate vom Flugzeug. *Anz. Schädlingsk,* i, No. 9.

(6) NEILLIE, C. R., and HOUSER, J. S., 1922.—Fighting Insects with Airplanes. *Nat. Geog. Mag., Washington D.C.* xli, No. 3.

(7) POST, G. B., 1924.—Boll Weevil Control by Airplane. *Bull.* 301, *Georgia State Coll. of Agriculture,* Vol. XIII, No. 4.

(8) WOLFF, M., and KRAUSSE, A., 1925.—Die Einführung der Arsenverstaubung vom Flugzeug aus in die Praxis der Forstschadlingsbekampfung. *Anz. Schädlingsk,* i, No. 9.

(9) Circular No. 71, Louisiana State University, 1924.

AGRICULTURAL METEOROLOGICAL WORK AT ROTHAMSTED

With special reference to Soil Temperature and Drainage.

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Introduction.—Given a proper supply of nutritive elements, the growth of plants and the yield at harvest is profoundly influenced by such factors as the water supply and the temperature of the soil. If either of these factors is in excess or deficit the crop suffers—excessive rainfall or drought and undue heat or cold all have an adverse influence. Although in such extreme cases the effects of the conditions are very evident, the influence is none the less close in normal seasons. The actual relationship is, however, very complicated, especially in a country like Britain, with a variable climate. It is one of the purposes of the crop-weather scheme of the Ministry of Agriculture to elucidate these relations, by the examination of records of weather and soil conditions and of crop growth and yield taken at a large number of stations over a period of years. When

these records are submitted to statistical examination it should be possible to disentangle the most important factors. We already know in a general way that certain types of weather conditions are much more important at some periods of growth than at others. For instance, unless the early stages of growth take place in a warm, moist soil, the plants will receive a severe check, and the effect of this may be reflected in the harvest some months later. Again, the ripening processes towards the end of growth are profoundly influenced if cold wet weather sets in.

At first sight it may seem that even if the relations between weather and crop yield become more clearly defined as a result of the crop-weather scheme, little of practical value will emerge, since once the seed is in the ground, the crop will be largely at the mercy of the ensuing weather. Although in broad outline this is true, yet there are many directions in which a closer knowledge of the relation between weather and crop can be turned to useful account. In the first place, it will add greatly to the accuracy of forecasting crop yields, which is an important economic necessity. In the second place, it will enable a number of minor alterations to be made in agricultural practice with reasonable certainty of benefit. The degree to which this can be done depends on the completeness of the statistical analysis of the records, and this in turn is dependent on the extent and completeness of the records themselves. Nor must it be assumed that it is only the weather conditions, after the crop is in the ground, that count. For some time past there has been definite proof of the effect on crop yield of weather and soil conditions at the end of the preceding harvest, or even earlier. When this aspect of the investigations becomes better understood considerable benefit should result. If it be found, for instance, that a certain type of weather and soil conditions during autumn cultivations is more inimicable to one winter-sown crop than another, the latter crop would be sown if such conditions occurred. Many other instances of a similar nature will no doubt arise when the crop-weather records are examined.

Effects of Weather on Crops.—The actual weather affects the crops directly or indirectly. The direct effects are typified by the action of sunshine, wind, rain, frost, etc., on the portion of the plant above ground. Such effects are too numerous to detail, and in this article it is proposed only to consider the indirect effects that are primarily those of sun and rain, acting on the plant roots through the intermediary of the temperature

and moisture conditions in the soil. To understand the probable nature of such effects it is first necessary to see what relations hold between the meteorological conditions and the soil conditions.

The moisture that plant roots draw upon is that in the top few feet of soil, hence it is important to know approximately what proportion of the rainfall is left behind in this layer and how much drains through to the lower depths. The records of the Rothamsted drainage gauges give invaluable aid in this respect and the long period over which they have been in operation enables reliable average values to be obtained. The gauges were erected in 1870, and consist of three blocks of undisturbed and bare soil, each 1/1,000 acre in area and respectively 20, 40 and 60 inches deep. These blocks are held in position underneath by perforated plates, below which, in a suitable excavation, collecting and measuring vessels have been installed. If we examine first of all the yearly averages, dividing them into three sets, of low, normal and heavy yearly rainfall, we obtain the following results :—

	Rainfall	*Drainage*	
	in.	in.	Per cent.
Below 26 in. ..	23·67	10·12	42·8
26 in.—30 in. ..	28·49	14·08	49·4
Above 30 in. ..	33·62	17·66	52·5

Percolation of Soils by Rain.—Thus, in this heavy loam soil, which is typical of large areas in England, about half of the rainfall drains through 60 in. of soil. The actual amounts are, as would be expected, greater in years of high rainfall. The portion that does not percolate is held by the soil, and is gradually reduced by subsequent evaporation. The extent to which this takes place depends on the season. In the summer evaporation is rapid, and occasionally crops receive little or no benefit from a shower, because the rain is held in the top layer and evaporates again before reaching the plant roots. The extent of this seasonal effect in bare soil can be seen from the following table, in which monthly averages are given.

In the summer months the soil is dry and little of the rainfall appears as percolation water. The rest is held by the soil and in large part evaporates again. As the winter approaches, evaporation is much reduced and the moisture content increases towards its saturation value, until in the winter months percolation forms a high percentage of the rainfall.

Monthly Amounts of Drainage through 60 *in. of Soil.*
Average of 45 *years* (1870-1, 1914-5.)

Month	*Rainfall* in.	*Drainage* in.	*Drainage* Per cent.
September	2·30	0·64	27·8
October	3·27	1·69	51·8
November	2·81	2·04	72·6
December	2 78	2·29	82·4
January	2·31	1·97	85·3
February	2·01	1·49	74·1
March	2·04	1·13	55·4
April	1·87	0·55	29·4
May	2·07	0·50	24·2
June..	2·44	0·65	26·6
July	2·58	0·60	23·3
August	2·66	0·62	23·3

Moisture Content of Soils.—The drain-gauge results discussed above give no direct information about the amount of moisture in the soil itself, and it is of course not feasible to sample the soils for that purpose. Information is, however, obtainable from the many determinations that have been made on the Rothamsted fields. The following table gives a range of values for three types of soil :—

Pore Space, Water Content, and Air Content of Certain Rothamsted Soils.

	Organic Matter Per cent by Weight.	Volume Occupied in Natural State by		Volume of Water		Volume of Air	
		Solid Matter	Air and Water (Pore Spaces)	In Normal Moist State	After Period of Drought	In Normal Moist State	After Period of Drought
Arable unmanured	4·3	66	34	23	17	11	17
Arable, 14tons dung per annum	10·0	62	38	30	20	8	18
Pasture	13·0	53	47	40	22	7	25

The table shows that there is about 35-50 per cent. of the total volume not occupied by the actual soil material. This pore space is in normal circumstances only partly filled with water. The remainder is occupied by air, which is only displaced when the soil becomes saturated and unsuitable for the growth of plants. Even in a period of drought there is still an appreciable quantity of moisture present in the soil, which is greater the larger the amount of organic matter present in the

soil. The effect of farmyard manure in increasing the supply of organic matter and thus enabling the soil to hold larger quantities of water without becoming waterlogged is of especial importance in periods of drought. On such occasions it is frequently noticed at Rothamsted that mangolds continue to grow on the plots receiving farmyard manure, while on adjacent plots receiving complete artificial manure, growth is temporarily stopped.

The moisture conditions during a drought are also of interest in showing the advantage of creating a mulch on the soil surface, to conserve the moisture in the lower depths of soil against evaporation. The effect is best seen on a fallow soil where the competition of plant roots for moisture does not enter. Just before the break of the drought in July, 1925, measurements were made of the moisture content at different depths on a fallow plot and an adjacent plot carrying a thin crop of wheat, with the following results :—

	July Drought, 1925	
Depth in.	Fallow. Moisture Per cent.	Cropped. Moisture Per cent.
0 — 2	4·55	7·7
2 — 4	4·75	7·05
4 — 5	8·3	7·35
5 — 6½	15·4	7 35
6½— 9	19·3	8·2
9 —13½	21·6	12·1
13½—18	22·3	15·0
18 —24	26·0	15·3
31 —34	—	18·4

The top 4 in. of the fallow soil had been dried out almost completely, and this layer had protected the moisture in the lower depths of the soil. The rapid increase of moisture content in the soil a short distance below the mulch should be noted. The gradual increase from 6½ in. downwards is partly due to the increasing heaviness of the soil with depth, which enables it to hold rather more water. The contrast between the fallow and cropped figures is interesting. The moisture demands of the plant have lowered the moisture content of the soil except in the top layers to about 50 per cent. of that in the fallow soil, and this effect is still marked at a depth of nearly 3 ft. In the top layers, however, the moisture content is actually higher than in the mulch of the fallow soil. This effect is mainly attributable to two causes : the crop, although a thin one, provides a certain amount of shade from the sun and protection from drying winds, and it is difficult for the crop to reduce the moisture content of the soil below a certain limit.

The moisture at low percentages is not "free" but intimately held by the soil, and the roots of the growing plant appear unable to remove it. The amount of this unavailable water increases with the heaviness of the soil.

Upward Movement of Soil Water.—Up to this point the moisture content of the soil has been regarded as obtained from the rainwater that percolates into it. The question now arises whether any appreciable addition to the soil moisture comes upwards from lower depths, either from a permanent water table, such as exists in the Fen soils of East Anglia, or from rainwater that penetrated initially below the range of plant roots. It is well known that water will readily ascend porous materials such as blotting paper, and a similar action in the case of soil can be readily demonstrated. Very diverse views have been expressed on the maximum height through which this upward movement of soil water can take place, and the estimates of different writers range from a few feet to hundreds of yards. Numerous laboratory experiments have suggested that the lower value was correct, but there has always remained the possibility that under natural field conditions the value might be much higher.

Some experiments made at Rothamsted would seem to dispose of this doubt. Cylinders 6 ft. deep and 2 ft. 6 in. diameter, closed at the bottom, were placed in the soil with the mouth at ground level. A thin layer of coarse gravel was placed over the bottom of the cylinder, and a long pipe 2 in. in diameter, with its lower end resting on the gravel, was held upright while soil was carefully filled into the cylinder. The cylinders were left for some years for the contents to settle down before systematic readings of the water-level in the 2 in. pipe were commenced. In the winter of 1920-1 the soil became saturated, as is usual in the winter months, because the impervious bottom of the cylinder prevented any drainage. With the advent of spring the upper layers gradually dried out and the water-level in the indicator pipe receded. Daily measurements of this level were made throughout the year. Over the period of the great drought the water-level in the cylinders containing bare Rothamsted soil fell rapidly to 28 in. below the surface in 30 days. After this the level fell less rapidly and had only receded a further 10 in. when the drought finally broke some 80 days later. The initial saturation of the soil and the sustained evaporation condition of the drought were both favourable to a state of affairs in which the water-

raising power of the soil should show to advantage. The low value obtained indicates that the moisture content of the top soil is not markedly replenished by supplies from below, and it emphasises the vital necessity of conserving, by appropriate cultivation operations, the somewhat limited store of moisture in the top soil.

Influence of Soil Temperature.—The soil temperature is scarcely less important than soil moisture in its influence on plant growth. The greater part of the work already published on these relationships under field conditions has depended upon very simple and rudimentary measurements of soil temperature. When a large number of observations have to be collected it is of course desirable to make the actual measurements as simple as possible, but with our present knowledge of the factors determining soil temperature it is obvious that considerable thought is needed before the actual type of measurement is selected. The main difficulty is that, at any moment, different layers of the soil are at different temperatures, hence the reading obtained on a thermometer depends both on the depth of its bulb and the time of observation. If the thermometer is placed always at a definite depth and read daily at the same time, readings of a fairly comparable nature will be obtained, but this raises the question of what are the best depth and time to choose in order to get the most representative reading. The cause of this difficulty is due to the daily rise and fall of temperature of the soil surface while it is heated by the sun and subsequently cooled by radiation. Heat is only slowly conducted downwards from the warmed surface, and hence at a few inches depth the temperature will be still rising although at the surface the maximum temperature for the day has been passed for some hours. In addition to this "time-lag" between the initiation of a temperature change at the surface and its appearance at a given depth of soil, the actual temperature fluctuation is also reduced. At the 6 in. depth in Rothamsted soil, for example, the maximum temperature in the summer is about 70° F.—considerably less than that of the soil surface, and it is not reached until about 5 p.m. In general it may be said that the soil temperature at any depth is a reduced image of that occurring on the soil surface; the maximum temperature is lower, the minimum is higher, and in addition there is a time-lag of several hours before the temperature wave reaches this depth.

In these circumstances no single reading could be expected to give very precise information as to the *quantity* of heat reach-

ing a given depth of soil, and a measurement of this quantity is as important as a knowledge of the actual temperature. An approximation that is sometimes used is the so-called "mean" temperature, which is the average of the minimum and maximum temperatures, but this necessitates some form of minimum thermometer for the former reading, as owing to the later rising of the sun in the winter, the soil temperature at the 6 in. depth does not begin to rise until midday, as against 7 to 8 a.m. in the summer. In the crop-weather scheme the maximum and minimum temperatures will be measured at two depths—4 in. and 8 in.—and in addition single daily readings will be taken at 1 ft., 2 ft. and 4 ft. At these distances the daily fluctuation of temperature becomes inappreciable, hence a reading at any convenient time will give a reliable value. Temperatures at this depth show a slow and fairly steady increase from winter to summer, and then a fall to the next winter. They give useful information as to the general weather of the season, and are of importance in studying the effect of season on the growth of deep-rooted crops such as fruit trees; but for ordinary farm crops, especially in their early period of growth, a knowledge of temperature nearer the soil surface is needed.

Fluctuation in Soil Temperature.—As a result of extensive measurements on soil temperature at the 6 in. depth at Rothamsted, it has been found that the daily fluctuations are practically inappreciable in the winter, but are marked in the summer. The rise in temperature which begins on the surface shortly after sunrise penetrates to the 6 in. depth at about 9 a.m. The temperature continues to rise until about 4.30 p.m., and the maximum is reached between then and 5.30 p.m. After this there is a fall, which is slower than the rise, and lasts for 15 to 16 hours. The mean daily temperature of the rising period is reached about midday and of the falling period about midnight. The warm period is therefore from midday to midnight. The extent of the daily rise of temperature is adversely affected by rainfall, but in the autumn rain prevents the soil from cooling as rapidly and as much as it otherwise would do. Although a slope of the land to the north or south is well known to have an important effect on its temperature, and therefore on the growth of plants, the actual magnitude of this effect is often not realised. The following figures show that it may be very considerable :—

	N. Slope	S. Slope
1½ in. depth	39·2° F.	54·3° F.
3 in. depth	37·8° F.	47·5° F.

It will be seen that the temperatures on the south side sloping towards the sun were very distinctly greater than on the north slope. The values were taken in the early spring when the warmer, and incidentally drier, conditions of the south slope would be of the utmost value in encouraging a good germination and a sturdy young plant.

In correlating soil temperature with questions of crop growth, it is necessary to remember that, as already observed, the soil is not at a constant moisture content. The rate at which a soil warms or cools, and the extent of the temperature rise, depend to a large degree on the moisture content. A dry soil has a low heat capacity and will warm to a high temperature on the surface, but it is a bad conductor of heat, and the temperature falls off rapidly in the lower layers. Water has a very high heat capacity, hence the same amount of heat will not raise the temperature of a wet soil to anything like that of a dry soil. On the other hand, the wet soil lets heat pass through it more quickly, and the lower depths may therefore show a rise of temperature before corresponding depths in a dry soil. Knowledge of factors of this nature is exceedingly important if the relation between crop and weather is to be worked out, and it is the purpose of the crop-weather scheme to obtain them in as complete a form as possible.

FERTILITY IN SHEEP

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INVESTIGATIONS on fertility in sheep have shown that the causes of differences in fertility between pairs of animals within a breed or between pairs of animals of different breeds, are of two types: the fundamental differences are genetic, but the degree of their expression is governed by environmental influences which are largely responsible for variations in fertility.

It has been shown by Hammond (1) that the limiting factor is the number of ova shed at each œstrous period, while Marshall (5) states that barrenness is normally caused by scarcity or absence of follicles available for ovulation while the ewes are with the rams for service. Among special causes which affect fertility are age of ewes (4), the proportion of rams to ewes, the methods of husbandry employed, climatic

conditions, and the district in which the flocks are kept (2, 3), and Marshall and Heape have both shown that nutritional causes affecting the condition of the ewes at tupping time are probably the most important of these special causes.

In 1924, a questionnaire was distributed to breeders of pure bred flocks with a view to the collection of further data on fertility, and an account of this investigation has already been given (9). In spite of the comparatively few returns obtained it was decided to continue the collection of such returns so that additional data, to supplement those already available, could be obtained, together, with information on seasonal variations in fertility. The questionnaire was distributed again in 1925, and the number of returns was again small, so that the results obtained probably do not truly represent the actual conditions in the different breeds but are sufficient for the purposes of this account. Twenty-seven of the returns obtained for the season 1924-25 were from one breed, and it is proposed to discuss these separately elsewhere.

TABLE I

Breed	No. of Flocks	No. of Ewes	No. of Lambs	Lambs per 100 Ewes
Border Leicester ..	12	215	389	181·0
Leicester	3	189	308	163·0
Shropshire	13	768	1,247	162·4
Suffolk	4	469	677	144·3
Lincoln	5	398	553	138·9
Dorset Horn	3	731	1,001	136·9
Hampshire Down ..	2	314	414	131·8
Romney Marsh	1	316	406	128·5
Oxford Down	6	654	830	126 9
Total	49	4,054	5,825	143·6

Data Presented.—The questionnaire was drawn up in such a way that a simple arithmetic check on the accuracy of the returns could be made, and from the figures available the following series of data were obtained :—

In Table I are given the numbers of ewes and lambs in each of the breeds from which figures were obtained and also the numbers of lambs per hundred ewes ; this last series of figures is used as a measure of fertility, the number of lambs being obtained from the data given under the heads, " number of cases of singles," " number of cases of twins," and " of triplets," in the questionnaire. The number of ewes is, in each case, the number put to the ram at time of service. In a few cases the number of lambs born was not recorded, but the number

alive, at the time of a count at the end of the lambing season, was given. The number of flocks is also shown, so that some indication of the degree of individual care of the ewes may be obtained, since in small flocks the ewes are usually much better cared for during pregnancy and at parturition than in large flocks.

The frequency of occurrence of multiple births is shown in Table II; and from a comparison of Tables I and II it is seen that high fertility is closely associated with high-percentage twinning. This association has been noted by various authors, but it is not complete because the questions of the proportions of barrenness and abortion among the ewes are also involved in the expression of fertility. Any differences in the figures given under "number of flocks" and "number of ewes" in Tables I and II are due to the fact that some returns did not give the number of lambs born under the heads of "cases of twins" and "cases of triplets."

TABLE II

Breed	No. of Flocks	No. of Ewes	Ewes with Twins	Twins per cent.	Ewes with Triplets	Triplets per cent.
Border Leicester	12	215	126	58·6	30	14 0
Leicester ..	2	122	75	61 5	0	0
Shropshire ..	13	768	444	57 8	32	4 2
Suffolk	3	340	202	59·4	8*	1 7
Lincoln	5	398	149	37·4	10	2 5
Dorset Horn ..	2	456	221	48·5	13	2 8
Hampshire Down	2	314	101	32·2	1	0 3
Romney Marsh ..	1	316	106	33·6	4	1·3
Oxford Down ..	6	654	251	38·4	14	2·1
Total	46	3,583	1,675	46·7	112†	3·0

* Out of 469 ewes. † Out of 3,712 ewes.

It is a matter of considerable difficulty for breeders and shepherds to keep records of the number of ewes which abort, since it is only abortions which occur later in pregnancy which are obvious in most cases. Early abortions may be classed as barren, and hence the figures given for barrenness and abortion are not strictly reliable, though they are more trustworthy for barrenness than for abortion. Table III gives the summarised data for the occurrence of barrenness and abortion in the breeds here considered.

The practice of flushing has been discussed by Marshall (5, 6, 7, 8) and others, and a series of comparative data were given in a previous paper (9). The practice is fairly widespread, but there is little evidence of a definite nature recorded.

TABLE III

Breed	No. of Ewes	Barren Ewes	Barren per cent.	Aborted	Aborted per cent.
Border Leicester ..	215	11	5·1	1	0·5
Leicester	122	3	2·5	—	—
Shropshire.. ..	768	22	2·9	3	0·4
Suffolk	340	4	1·2	27*	7·9
Lincoln	316	6	1·9	7†	1·8
Dorset Horn ..	731	33	4·5	3‡	0·7
Hampshire Down..	314	3	1·0	—	—
Romney Marsh ..	316	20	6·3	4	1·3
Oxford Down ..	654	56§	8·6	23	3·5
Total ..	3,776	158	4·2	68‖	1·9

* The majority of these occurred particularly in one flock where the pregnant ewes were known to have been disturbed by dogs and where, in addition, the winter was abnormally wet.

† Out of 398 ewes.

‡ Out of 456 ewes.

§ In one small flock containing about 30 per cent. shearlings, 80 per cent. of these never took the ram, for which no reason could be given by the breeder.

‖ Out of 3,583 ewes.

TABLE IV

Breed	No. of Ewes	No. of Lambs	Lambs per cent.	Sex-ratio (Males per 100 Females)
Border Leicester ..	16	31	193·7	106·7
Leicester	67	115	171·6	—
Shropshire	233	380	163·1	72·7
Suffolk	168	214	127·4	106·8
Lincoln	91	129	141·8	115·0
Dorset Horn	204	380	186·3	111·1
Hampshire Down ..	127	174	137·0	96·5
Oxford Down	127	166	130·7	115·5
Total	1,033	1,589	153 9	98·1

TABLE V

Breed	Ram Lambs	Ewe Lambs	Males per 100 Females
Border Leicester ..	193	190	101·6
Leicester	109	84	129·8
Shropshire	605	642	94·2
Suffolk	340	336	101·2
Lincoln	191	199	96·0
Dorset Horn	506	495	102·2
Hampshire Down ..	194	213	91·0
Romney Marsh	206	189	109·0
Oxford Down	410	405	101·2
Total	2,754	2,753	100·0

In Table IV have been grouped data from the flocks stated to have been flushed irrespective of the precise manner of flushing. The sex ratio in the flushed flocks is also given. Table V shows the sex ratios in all the flocks considered.

The numbers of flocks in each breed for which data were available for both seasons, 1923-24 and 1924-25, are shown in Table VI, with the summarised data for each breed, and in the case of Border Leicester, Leicester, Shropshire, Suffolk, and Oxford Down breeds, it was possible to obtain data for a total number of 253 yearling ewes. This series of data is compared with that of the total for these breeds in Table VII.

TABLE VI

Breed	No. of flocks	Lambs per cent. 1924	Lambs per cent. 1925	Sex-ratio per cent. 1924	Sex-ratio per cent. 1925	Barrenness per cent. 1924	Barrenness per cent. 1925	Abortion per cent. 1924	Abortion per cent. 1925
Border Leics.	11	186·5	168·1	98·3	104·1	2 6	5 2	1 6	0 5
Leicester ..	2	158·1	168·1	74·5	139·2	—	—	—	—
Shropshire ..	3	157·5	175·3	96 4	70·2	1·4	0	1·4	0
Suffolk ..	2	154 0	124·1	103·1	94·7	—	—	—	—
Lincoln ..	5	137·4	138·9	91·9	96·0	—	1·9	—	1·8
Dorset Horn	3	137·7	136·9	79·4	102 2	2·4	4·5	1·2	0·7
Hants Down	1	121·2	128·3	90·9	87 5	2·6	0	0	0
Romney Marsh	1	111·4	128 5	—	—	4·0	6·3	1·2	1·3
Oxford Down	6	132·1	126 9	92 0	101·2	3·1	8·6	4·4	3·5

TABLE VII

	Lambs pr cent.	Twins pr cent.	Triplets pr cent.	Barren pr cent.	Aborted pr cent.	Sex-ratio pr cent.
Total	150 3	52·3	3·8	4·6	2·6	100
Yearling ..	138 4	46·0	3·4	8 3	6·3	94·6

Discussion.—The date presented above must not be considered as truly representative of the breeds; the arrangement according to fertility in Table I differs from similar tables drawn up by previous authors, though it is perhaps noteworthy that the Border Leicester and Leicester flocks show the highest fertility in both seasons, 1923-24 and 1924-25. But certain general conclusions as to the causes of fertility in sheep can be made.

That the fundamental basis of fertility is of an hereditary nature is well proved by the facts that breed differences exist between flocks kept under the same or similar conditions, and that it is possible to build up strains of different levels of fertility by selective breeding, while much evidence in support is available from studies of the smaller

animals and also from studies of infertility and sterility which show that genetic factors are involved. Apart from the primary hereditary causes, fertility is influenced by those factors which affect barrenness and abortion, since high fertility depends on a high percentage of multiple births associated with low percentage of barrenness and abortion. This is clearly demonstrated by comparison of Tables I, II, and III. Flockmasters generally have reported that the season 1924-25 was bad for high yields of lambs, and it is obvious from Table VI that increases or decreases in fertility from year to year are very closely associated with decreases or increases in the percentages of barrenness and abortion. It has also been shown (8, 9) that there is some association between barrenness and low percentage of multiple births, with the conclusion that barrenness in the sheep may normally be due to causes similar to those which produce a scarcity of twins and triplets, and that nutrition of the ewe at time of service may probably be one of the most important of these causes.

It is known that those environmental factors of nutrition and management which produce in the ewes an "improving condition" at tupping time are conducive to higher yields of lambs. The effect of flushing is to produce a high state of nutritional activity in the ewes, and the results of this practice are clearly shown by comparison of Tables I and IV, where in every breed, except the Suffolk, the fertility of flocks which have been flushed is higher than the total for the breed, and the total fertility of all flushed flocks is higher than the total fertility of all the flocks considered. Flushing must be practised every season for its effects to be sustained, and there are records which show that if it is discontinued for a season a marked reduction in fertility, even beyond the breed average, results in that season. It would appear also that the manner of flushing is not so important as the fact that it has been practised; the ewes come on heat quicker and in larger numbers, so that more lambs are born earlier in the lambing season. It might be suggested that it would be good policy to increase the number of rams in use to ensure that more ewes are served at their first (and more fertile) heat periods.

The management and food supply of the flock influence barrenness and abortion, except in those cases where abortion is due to definite pathological causes. At tupping time such factors as the removal of obstacles to service and the proportion of ewes per ram need attention, as these may affect

the proportion of barrenness, while, during pregnancy, abortion may be prevented in some measure by management, ensuring that the ewes are maintained in a steady condition at first and that all predisposing causes (such as "sheep sour" land, leading to debility) are, as far as possible, eliminated. A high, or fat, condition, such as is common among show sheep, is antagonistic to high fertility, for either physical or pathological reasons.

Another cause of abortion cannot be overlooked, and that is where abortion is due to atrophy of the fœtuses. It has been shown by Hammond (1) that in sheep the majority of atrophic fœtuses occur at an early stage of development, and lethal factors leading to abortion have been demonstrated in sheep and many other animals—barrenness may be due to such factors acting at very early stages of pregnancy. It has also been shown (2) that the ewes of some breeds, *e.g.*, Wensleydale and Suffolk, tend to produce fewer lambs with rams of other breeds than with rams of their own breed, and it has been pointed out (9) that some breeds which show a low sex ratio have a similar tendency. In many cases, where lethal factors are known to act, they do so more particularly on the male sex, and there are indications that, in the Hampshire Down breed, lethal factors may also be acting. It is possible that the higher fertility exhibited in certain crosses is due to the introduction of dominant partners of lethal factors by the cross.

Jones and Rouse (4) have shown that five-year-old ewes give the highest yield of lambs, but this does not indicate that this is the best age at which to obtain lambs; such age must be determined largely by economic considerations in particular districts. However, the data available for certain of the breeds (Table VII) show that the fertility of yearling ewes is less than that of older ones, the incidence of barrenness and abortion being greater.

From investigations involving large numbers it has been shown that the sex ratio in sheep may be considered as about 97 males per 100 females, but in small numbers there can be much seasonal variation (Table VI). It might appear that flushing has some effect on the sex ratio, as is often maintained by certain breeders, but, though it is possible that some effect may be produced by subsequent alterations in the nutritive supplies to the fœtuses, and thus some variation in the conditions affecting early differential mortality, the differences in sex ratio shown in the tables presented do not

provide significant evidence of such an effect in view of the considerable variations which exist.

The author wishes to pay his grateful acknowledgement to all breeders who have contributed records of their flocks, to the British Research Association for the Woollen and Worsted Industries for enabling him to carry out this and other investigations, and to Dr. F. A. E. Crew, of the Animal Breeding Research Department, the University, Edinburgh, for much valuable help and criticism throughout the course of this study.

Summary.—(1) The causes of variation in fertility are environmental conditions acting on hereditary differences, the most important being those which produce a high proportion of multiple births and a low proportion of barrenness and abortion.

(2) High lambing percentages can be produced by the practice of flushing, by reason of the increased reproductive activity of the ewes at the beginning of the period of service induced by the nutritional stimulation following the flush.

(3) Barrenness and abortion (apart from pathological conditions) are largely due to environmental factors, but hereditary factors may also play a part in determining their incidence. Barrenness and abortion are more frequent among the younger ewes.

LITERATURE.

(1) *Hammond, J.* "Further Observations on the Factors controlling Fertility and Fœtal Atrophy." *Jour. Agric. Sci.*, v. 11, 337-366. 1921.

(2) *Heape, W.* "Note on the Fertility of different Breeds of Sheep, with remarks on the Prevalence of Abortion and Barrenness therein." *Proc. Roy. Soc.*, B, v. 65, 99-111. 1899.

(3) *Heape, W.* "Abortion, Barrenness, and Fertility in Sheep." *Jour. Roy. Agri. Soc.*, v. 10, 1899.

(4) *Jones, S., and Rouse, J.* "The Relation of Age of Dam to observed Fecundity in Domesticated Animals. I.—Multiple Births in Cattle and Sheep." *Jour. Dairy Sci.*, v. 3, 260-290, 1920.

(5) *Marshall, F. H. A.* "Fertility in Sheep." *Trans. High. and Agric. Soc., Scot.*, 24-43, 1904.

(6) *Marshall, F. H. A.* "Fertility in Scottish Sheep." *Proc. Roy. Soc.*, B, v. 77, 58-62, 1905.

(7) *Marshall, F. H. A.* "Fertility in Scottish Sheep." *Trans. High. and Agric. Soc., Scot.*, 131-151, 1908.

(8) *Marshall, F. H. A.* "The Effect of Environment and Nutrition upon Fertility." *Sci. Progr.*, No. 7, 1908.

(9) *Nichols, J. E.* "Fertility in Sheep." This *Journal*, December, 1924.

A SUCCESSFUL AGRICULTURAL CO-OPERATIVE SOCIETY

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AT a very interesting Conference held at Wembley in July, 1924, Mr. Dunning, the Prime Minister of Saskatchewan, in a speech which should be read by every agriculturist in this country, said :—

> Labour is organised to-day to get a living wage; capital is organised to secure a return upon the capital invested. The farmer is the one man in all creation who, when he buys, says: "What is the price ?" and when he sells asks exactly the same question. Other industries when they buy have something to say regarding the price, and certainly, when they sell, have a great deal to say about it.

There is no doubt, too, that the farmer too frequently buys in the retail and sells in the wholesale market.

During July and August of 1924, the writers had an opportunity of visiting Denmark and Switzerland and seeing what has been done in these two countries by means of co-operation in the collective purchase of farm requisites, and the collective disposal of farm products, and they are firmly convinced that the wonderful success of the farming industry in both of these countries would have been absolutely impossible but for the business organisation there existing, for both buying and selling.

During the summer of last year, a further opportunity occurred of visiting some forty or more agricultural co-operative ventures of various kinds in England and Wales. There is no doubt that organisation for the disposal of agricultural products is more needed here than organisation for the purchase of agricultural requisites; yet, peculiarly enough, it is the latter type of co-operative venture which has been most popular both in England and Wales, and has been financially the most successful.

Thus, according to the agricultural returns, which have duly been prepared by the Registrar of Friendly Societies for the year 1924, the number of agricultural co-operative requisite societies for that year was 554, with a membership of 98,675. These societies had a turnover of £8,853,704, paid a wage bill of £340,355, and made a net profit of £59,439. On the other hand, the number of agricultural co-operative societies

in Great Britain for the sale of agricultural produce was, in the same year, only 238, with a membership of 34,888, and a turnover of £3,673,516. These societies paid a wage bill of £167,125, *but made a financial loss of* £6,017.

While the year's working of the agricultural requisite societies left an average profit of just over 12s. per member, the year's working of the agricultural co-operative societies for the disposal of farm produce resulted in an average loss of 3s. 6d. per member.

Looking at the agricultural ventures in Yorkshire, we find there are registered in the county to-day, 26 co-operative societies for the purchase of farm requisites, but only eight co-operative societies for the disposal of agricultural produce. In these circumstances, we have thought it best to direct our attention first of all to a detailed study of a few of the most successful of the former type of co-operative venture. Of these, a very interesting group is to be found in South Wales, and of that group possibly the most interesting, instructive, and successful that we have yet met with is the Carmarthen Farmers' Co-operative Society.

The relative importance of co-operative requisite societies in Wales is strikingly shown in the following summary taken from "A Survey of Agricultural Co-operation in the Empire":—

Table I

	North Wales	South Wales	Wales
Societies	61	56	117
Members	9,983	15,387	25,370
	£	£	£
Total Capital	65,383	103,297	168,880
Sales (*a*) Requisites	426,132	826,587	1,252,719
(*b*) Produce	56,749	169,299	226,048
(*c*) Total	482,881	995,886	1,478,767

Of the £1,478,767 turned over by the whole of the Welsh agricultural co-operative societies in 1922, £1,252,719 or 87·7 per cent. represents the turnover of requisite societies, as compared with £226,048 or 12·3 per cent. of the total turned over by produce societies.

Origin of the Society.—The Carmarthen Farmers' Co-operative Society has been described in a recent survey of "The Co-operative Purchase of Agricultural Requisites in England and Wales"* as being a typical example of a Welsh

* Ministry of Agriculture and Fisheries: Economic Series, No. 5, 1925. Published by H.M. Stationery Office, price 1s. 6d. net.

store society. The early formation of this successful society was directly due to the report of a Welsh County Council deputation which visited Ireland in 1902. "Whether or not," said the deputation on their return, "there may exist a difference of opinion respecting the adaptability of the co-operative creameries to the Welsh counties, the advantages attending the establishment of agricultural societies cannot fail to strike the most reactionary farmer. In Ireland these societies are the principal distributors of agricultural requirements; their capital is small, but by means of their associated credit they are able to purchase goods in large quantities on infinitely more favourable terms than can any individual. They purchase for their members, seeds, manures and feeding stuffs, and the delegates cannot too strongly urge the importance of establishing agricultural societies in the Welsh counties upon the lines here laid down."

Acting on this advice, a small body of men got to work immediately, and actual trading commenced on a small scale, with a purchase of 23 tons (mainly of barley meal), on October 7, 1903. By this time 80 members had been enrolled to form the Carmarthen society, with a total share capital of £85. A manager had been appointed, and he was the only man in attendance at the store. The executive committee were anxious to know where they stood at the end of the first six months' trading, and the first balance sheet and trading account, showing a profit of £86 1s. 10d., was submitted to a specially called general meeting of the Society. The action of that first general meeting was typical of the soundness of the financial policy which they have adopted right through, for it was there resolved that

> This balance of £86 1s. 10d. in favour of the Society be carried forward to a Reserve Fund, and that such rules of the Society as are to be complied with in its transference be rescinded for that purpose.

From that day to this, the Society has never looked back; its membership has grown until to-day it stands at 2,180. Its turnover, which in the first year of its existence was £5,910, reached its maximum of £226,933 in the days of high prices in 1920, and in 1924 amounted to £190,568. In no single year of its existence, even in the years of the slump, has there been any financial loss. The total profit made by the Society up to 1924 has been well over £50,000, of which approximately £21,000 has been paid to the members in the form of bonus; £23,000 has been made over to the members in the form of

bonus shares ; and £8,211 has been left in the business in the way of reserve. The total shares actually taken and paid up by the members only amounted to £1,913, approximately £1 per member. This building up of the capital of the Society has been sound and careful finance, and the steady building up of reserves out of these profits has been very interesting to watch. The total profits made in the first four years, amounting to over £2,000, were all carried to reserve.

It was not until the end of the fifth year, when an accumulated profit of £3,000 had accrued, that the first dividend of 2d. in the pound for the first five years was declared. Up to the outbreak of the War, dividends varying from 3d. to 5d in the pound were declared each year, and in this way nearly £6,000 was distributed to the members, though reserves of accumulated profits to the extent of approximately £10,000 were still being retained. During the years of the War, when large profits were being made—in 1916 up to nearly £6,000—not a penny was given back to the members in the form of bonus or dividend. The Executive and Management Committee, doubtful as to what the aftermath of the War might leave, thought it best to husband their resources, and the members loyally fell in with their suggestions.

By the end of 1920 the reserves had mounted up to £30,533, and bonus shares to the extent of £23,000 were then distributed to the members in proportion to their total purchases since the formation of the Society. Since that time, dividends up to 6d. in the pound on the total purchases have been declared each year, and interest on the share capital of from 5 to 10 per cent. has always been paid. The Society stands to-day in a sound and unshakeable position, with total assets to the value of over £38,000, although a share capital of less than £2,000 has actually been paid in by the members themselves.

The main premises of the Society are situated in Carmarthen, but branch depots have been opened out at different times in various parts of the dairying districts from which the membership is almost entirely drawn. Very few non-members are supplied, but nearly half the membership is said to give practically the whole of its trade to the Society. Each member is supposed to hold at least four shares of 5s. each, and to pay for his purchases within fourteen days of the end of the month in which the purchases were made. The small figure of £150 for bad debts, written off during the whole of the trading period, indicates, in a remarkable manner, the loyal support on the part of the members.

Possibly the two things which appear to stand out most prominently in the history of this Society are :—

(*a*) The sound and careful management of the Directorate, and
(*b*) The absolute loyalty of the members to the Management of the Society.

As far as can be seen the "cost plus" system of selling has never been attempted, the Society's policy being to sell at or as nearly as possible at the market price, and at the end of the year to declare dividends on the value of the purchases made.

The following table, summarised from the Report* already referred to, gives some idea of the consistently steady and successful growth of the Society since its commencement :—

TABLE II

Year		Membership	Capital	Sales	Profits	Reserves
			£	£	£	£
1904–08	..	451	361	20,572	632	1,226
1909–13	..	1,109	818	73,406	1,646	5,678
1914–18	..	1,537	1,243	129,033	2,886	16,383
1919–23	..	1,886	20,613	217,874	5,905	19,928
1924	..	2,180	25,203	190,568	5,011	8,211

Trading Efficiency.—Trading efficiency in a co-operative purchase society is only to be distinguished from that in a joint stock concern, in that profits ultimately go, in the first case, to the purchasing members. In both cases, if financial success is to be assured, the goods must be bought well and sold well, the working costs must be kept low, and the capital turnover kept high.

In the case of a multiple purpose society like that of the Carmarthen Farmers', it would be difficult, if not almost impossible, to see how far the price paid by the Society for the goods purchased was above or below the market price.

Buying and Selling : Credit Taken and Given.—With regard, however, both to buying and selling, there are, in the accounts of the Society, several strong indications that the management has been in an exceptionally strong position in both these respects. In order to take proper advantage of trade discounts in buying, a society must be prepared to make ready payments for its purchases.

In the case of 9 co-operative requisite societies whose accounts we have so far investigated :—2 have paid for their purchases within 7 weeks of the date of invoice, 1 has paid for its purchases within 6 weeks of the date of invoice, 1 has

* *See* footnote, page 227

paid for its purchases within 5 weeks of the date of invoice, 3 have paid for their purchases within 3 weeks of the date of invoice, 1 has paid for its purchases within 2 weeks of the date of invoice, and the Carmarthen Farmers' Society in well under 14 days.

It should be remembered that all accounts are not subject to the same terms, some being due in 7 days, others in 14 and 28 days from the date of invoice, and others again on the 10th of the month following delivery. It would appear, however, from the fact that on the average, as is shown in the following table, payment has been made within 11·4 days of the date of invoice, the Carmarthen Farmers' Society has paid all accounts *on* or *before* the date on which they became due.

Table III

Accounts Due and Owing

Year	Total sales £	Amount due by members £	No. of days' credit	Total purchases £	Amount owing £	No. of days' credit
1904-08	20,572	482	7·72	18,701	618	12·86
1909-13	73,406	2,134	10·9	69,857	2,214	11·6
1914-18	129,033	4,036	11·58	124,500	5,702	15·62
1919-23	217,874	6,462	13·06	166,968	4,382	9·64
1924	190,568	8,558	16·6	180,513	4,834	9·7

The inter-relationship between credit allowed and credit received is a very important factor in the financing of any business, whether co-operative or otherwise. In the co-operative societies whose accounts we have had an opportunity so far of studying, its influence can be traced both in the requisite and produce societies.

In the case of two egg-collecting stations, handling approximately the same number of eggs per year, both societies pay their members in hard cash for the eggs purchased on the actual day purchased. One gets a settlement once a week for its disposal with the merchants to whom the eggs are sold, and the other once a month; with the result that one society has to have available cash to meet the working expenses of one week and the other of four. It is significant that in the former case the called-up capital at the present time is £1 0s. 4d., and in the latter case £3 1s. 5d. per member; in the former case there is available a cash and bank balance of £669 14s. 10½d., while in the latter case there is an overdraft of £646 10s. 0d.

The acme of good salesmanship in the case of a joint stock company is to sell heavily at a high price to people who are sound financially and who will pay promptly.

In the case of a co-operative requisite society, where all the profits should be going back to the members, there should be no need to look for a high margin between the buying and selling price; at Carmarthen this has averaged, right through, rather less than 6 *per cent.* on the total turnover, and throughout the whole twenty-one years has remained wonderfully constant. The soundness of the management in buying and selling is shown in one way by the fact that the full credit allowed to the society, without any financial loss in the way of discounts, is passed on practically *en bloc*, but in no great excess to its members.

One requisite society in South Wales receives 6½ weeks' credit from the trade, and in doing so loses practically the whole of the trade discount, but allows three months' credit to its members, with the result that, in spite of the fact that well over £6,000 net profit has been made by the society, not one penny has found its way into the pockets of the members in the form of bonus or dividend; the whole of the accumulated profits having to be left in the business, to finance it.

In the case of a second requisite society in South Wales, 2 weeks' credit is taken by the society from the trade, and 12 weeks' credit given to the members. Here full advantage is taken by the management of the trade discount, but the members are made to pay for their credit in being charged comparatively higher prices, this being shown by the fact that the gross margin is more than 10½ per cent. of the turnover, as compared with less than 6 per cent. in the case of the Carmarthen Farmers'.

Good salesmanship of the highest type is seen in the fact, to which reference has already been made, that the bad debts incurred by the society throughout the whole of the trading period have amounted to only £150. There are also in the trading history of the Society strong indications that an intelligent policy of buying and selling has always been pursued.

The proportion of purchases on hand, during the period under review, indicates very clearly the efficiency and responsiveness of the management to variations in the price level and in general trading conditions. During the times of rising prices, there is evidence to show not only that they were

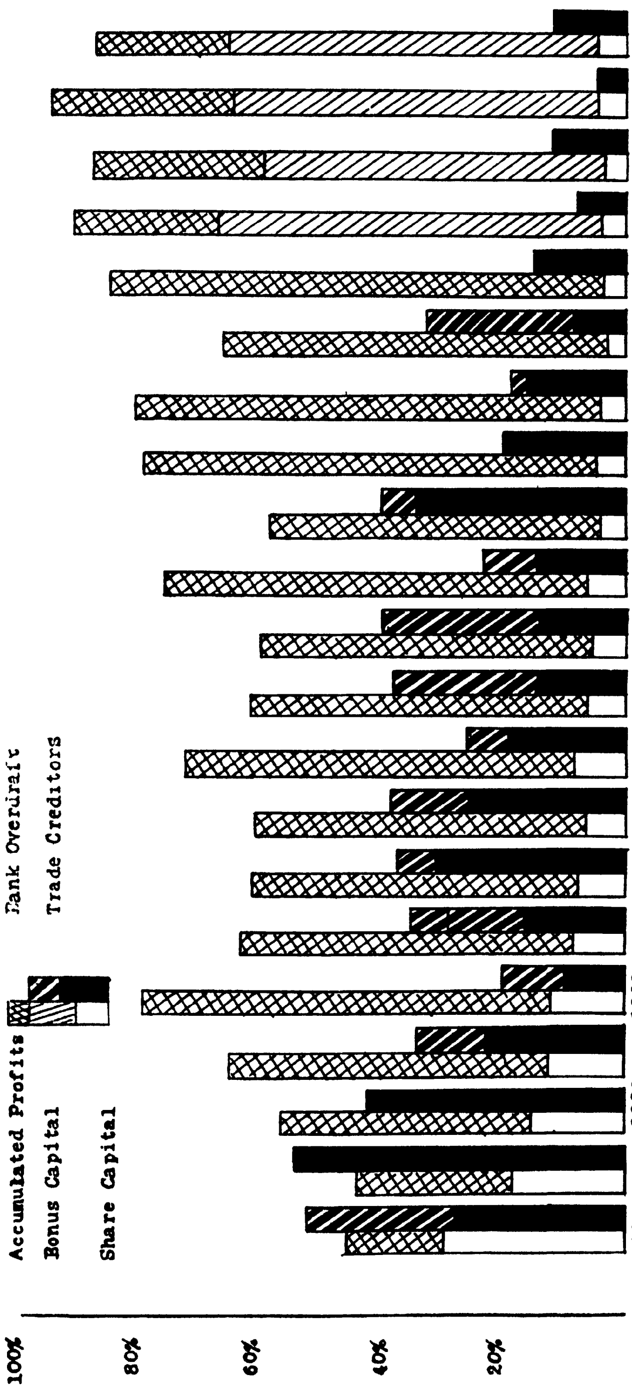

FIG. 1.—Liabilities: How the Business is Financed.

buying ahead of their requirements, but that the policy of holding over a disproportionately large amount of stock was being deliberately undertaken, in order to secure benefits for the members. In order to do this, it was again to a large extent inevitable that they should depart from their usual policy of cash payments, and have to accept longer credit from the trade.

When, however, the post-war slump arrived, we find the management buying in small quantities, quickly unloading their stocks, and, in order to do so, relaxing to some extent their demand for prompt payment from the members and giving longer credit. This timely policy has effected a result affording a very strong contrast to that obtaining in the case of those societies who, in continuing their policy of buying forward too far into the slump, are now landed with heavy adverse balances.

Working Costs.—Whilst the success of the Society can be largely accounted for by the strength of its position in the market, the argument would be incomplete were no mention made of the working costs, which have been kept consistently low, averaging right through just under 3 per cent., and leaving a net profit of just over 2½ per cent. on the turnover.

It is interesting to find that this Society, unlike many other similar Welsh societies, has throughout thought that the labourer was worthy of his hire, and paid not only a good salary to the Manager, but also good wages to all the men who are employed; and it is still more interesting to find that, as each year the financial position of the Society became more and more sound, a relatively higher proportion of the total turnover went to meet labour charges.

In the first five years of the Society's existence, salaries and wages represented 1·53 per cent. of the total turnover; in the last five years 2·4 per cent.

The payments for salaries and wages represented :—

In the period	1905-1909	..	42·6 per cent. of total working costs.
„ „	1910-1914	..	47·8 „ „ „
„ „	1915-1919	..	57·5 „ „ „
„ „	1920-1921	..	60·1 „ „ „

The steady growth of the salary and labour charges is not without significance. It suggests that the Carmarthen Farmers' have realised that it is just as important that a co-operative society should be as efficiently represented on the market as is usual in the case of an ordinary joint stock company. Too

frequently one finds in an agricultural co-operative venture that the manager is not too well paid. This policy is undoubtedly false economy from whatever viewpoint we regard it. It fails to attract the most enterprising type of man, and poor reward is often the parent of poor service.

Capital Turnover.—While a net profit of just over 2½ per cent. on the turnover is not high, yet, when one considers that the turnover is now nearly a quarter of a million sterling per annum, it is easy to see that this represents a high return on a share capital of under £2,000 actually paid in. In 1924, the total sales amounted to £190,567, the capital actually subscribed to £1,913, and the total net profit to £4,723. The subscribed capital was therefore turned over approximately 100 times, and the net profit represented one of 246 per cent. The owned capital, including the bonus shares and undistributed accumulated profits, amounted to £33,413, so that the owned capital was turned over 5·8 times and the net profit represented one of rather more than 14 per cent. The total liabilities of the Society, including owned and borrowed capital, amounted at that time to £38,248; thus the total capital was turned over 4·9 times, resulting in a net profit of 12·1 per cent.

Taking the five-year average, we find that there has been a very marked falling-off in the net profit expressed as a percentage of the owned capital. This might be expected, as the increasing proportion of the total liabilities came under the heading of "owned capital." Borrowed capital can be obtained at the rate of from 4½ to 5 per cent., and a well-managed business should make more.

TABLE IV.—NET PROFIT EXPRESSED AS

Five-year period	Per cent. of owned capital	Per cent. of total liabilities
1905-1909	60·6	36·7
1910-1914	30·5	19·0
1915-1919	23·1	15·1
1919-1924	14·0	12·3
Average	32·0	20·8

On the other hand, it is difficult at first sight to explain satisfactorily the steady drop in the financial return on the total capital invested in the business, though some suggested reasons for this may be given later.

Capital Invested in the Business.—A study of the balance sheets shows that, at the end of the first year, the total capital invested in the business amounted to £696 14s. 0d., and that

this had steadily grown until on December 31, 1924, it amounted to £38,248 6s. 3d. The distribution of these assets is interesting, and forms an instructive object lesson to many of our English societies. Throughout the whole period, on the average,

11·7	per cent.	of the	capital	has	been in	land and buildings,
3·7	,,	,,	,,	,,		investments,
56·9	,,	,,	,,	,,		stock in trade,
18·9	,,	,,	,,	,,		giving credit to members,
8·8	,,	,,	,,	,,		cash and liquid assets.

It will be seen that not too big a proportion has been locked up in bricks and mortar or in other non-productive assets. The buildings are by no means elaborate, and possibly might be a little more convenient, but everything that is really necessary for the storage of goods or the convenience of the office staff is provided.

By far the larger part of the capital, as one would expect in a "store society," has been invested in stock-in-trade. Long credit has never been given, and apparently the terms of the business have been fairly rigidly adhered to.

Signs of over-capitalisation are undoubtedly shown in two periods when cash and liquid assets have been accumulating. The capital required to finance the working of the Society during the war period of high prices was obviously more than sufficient in the "control" period, and to a much greater extent in the slump years of the post-war period—a state of affairs which may be described as being wholly abnormal, and one which has reduced several similar undertakings, working with a much narrower margin of owned non-interest-bearing capital, to the verge of bankruptcy.

There is no doubt that, during the last four years quoted the Society was distinctly over-capitalised, and was so in spite of the fact that in 1924 the total assets per member in the Carmarthen Farmers' was the lowest we have as yet met with, as can be seen from the following summary :—

TABLE V

Requisite Society		Total assets per member, 1924 £	s.	d.
Carmarthen Farmers'		18	16	0
Welsh Society	A	22	12	0
	B	22	14	0
,, ,,	C	27	8	0
English Society	A	44	8	0
,, ,,	B	71	18	0
,, ,,	C	80	10	0
Welsh Society	D	91	15	0

How the Society has been Financed.—It is clear that efforts have been made by the Executive to finance the project from within. Starting with only £80 subscribed capital, strengthened by a joint and several guarantee by the Executive of £1,000 to the bank, this Society was enabled to sell requisites to the value of £59,100 in 1904. At the end of the first year's trading the liabilities amounted to £696, of which about 20 per cent. was owing to the bank and 30 per cent. to sundry trade creditors, representing a total borrowed capital of rather more than 50 per cent.

The following summary of the five-year averages, 1905-9, 1910-14, 1915-19, and 1920-24, shows how, by the judicious retention of accumulated profits, the proportion of owned capital has been steadily increased until it approached to nearly 90 per cent. of the whole.

TABLE VI

Period	1905-09	1910-14	1915-19	1920-24	Average
	Pr. cent.	Pr cent.	Pr. cent.	Pr. cent.	Pr. cent.
Share capital	14·0	7·8	4·6	4·3	—
Bonus capital	—	—	—	48·0	—
Accumulated profits ..	48·5	55·9	67·6	36·9	52·2
Total owned capital ..	62·5	63·7	72·2	89·2	71·9
Bank overdraft	7·8	14·8	6·1	1·2	7·5
Trade creditors	29·7	21·5	21·7	9·6	20·6
Total borrowed capital	37 5	36·3	27·8	10·8	28·1
Total capital ..	100 0	100 0	100·0	100·0	100·0

There has been a steady and gradual increase in the percentage of the capital invested in the business, and owned by the members, right up to the time of the present strong position. The benefits of such internal capitalisation lie mainly in the fact that substantial advances from the already depleted capital of the farmers are rendered unnecessary. On the other hand, there is evidence in the trading history of the Society to show that refusal to take advantage of the normal facilities for trade credit may react to the detriment of the concern so refusing. A policy of internal capitalisation can be, and possibly, in the case of the Carmarthen Farmers', has been pursued to a point at which its usefulness tends to grow less. It is probable that this point is reached before actual over-capitalisation becomes apparent. Normally, in a trading concern, the bank overdraft should prove an excellent indicator as to the adequacy of the working capital. On the other hand, a persistent bank balance cannot but be regarded as an indication of ill-economy in the form of over-capitalisation. It would appear as if the most effective ratio of borrowed

and owned capital is reached when the bank overdraft tends to approach a minimum. This point represents the economic compromise between losses from idle capital on the one hand and losses from inefficient purchasing power on the other. Necessary elasticity, normal to this type of business, ought obviously to be provided more economically by the banker, whose main function it is, than by the creation of abnormal reserves on the part of the individual society.

There is no doubt in our opinion that this mark has been to some extent over-reached in the case of the Carmarthen Farmers'. It may seem captious to criticise the management of a society like this, in which the members have put into the business under £1 per head, have already received in the form of bonus approximately £10 per head, and in which, were the Society wound up to-morrow, there would be available for distribution, after meeting all liabilities, nearly £16 per head. On the other hand, one cannot but feel that it was a bold, and, possibly, not too wise a step, to create interest-bearing bonus shares to the extent of £23,000 and still leave in the bank more than £12,000 for which a nominal interest only could be drawn.

The management and direction, as far as we have been able to see, has been sound and efficient, but there is no doubt that the success of the Society has also been built up to a large extent on the goodwill of the founding and early membership.

While the Carmarthen Farmers' Society is not, from a business point of view, absolutely perfect, and has possibly erred as a rule on the side of caution, it has been as nearly perfect as any we have yet met with, and there is no doubt that the detailed working of this Society might with advantage be studied by those who are concerned with the management of similar concerns in this country.

RAISING HYACINTHS IN HOLLAND

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THE hyacinth is one of the most popular members of that large natural order of plants known as the Liliaceæ. Of the spring-flowering plants it is one of the earliest to reveal its bloom, and a full-grown hyacinth in flower carries with it a

type and standard of beauty which strikes one as being essentially Dutch. But the Dutch hyacinth is not a native of Holland. It is recorded that it was introduced quite unostentatiously into Holland during the sixteenth century, and that it is a descendant of *Hyacinthus orientalis* which grows wild in Greece and Asia Minor. This wild hyacinth is an insignificant plant, which has a small round bulb, and when it flowers, its spike carries a few narrow-lobed, washy blue flowers not unlike the wild bluebell found in the woods of England. *Hyacinthus orientalis* found a comfortable home in the sand dunes of Holland, and the Dutch have, through decades of patient seed-sowing and selection, brought it to its present high state of development.

The history of the Dutch hyacinth reveals a slow but continual improvement in the varieties raised, but popular fancy once determined that it should evoke a degree of enthusiasm out of all proportion to its merits. When double hyacinths, now not at all popular, were introduced into commerce, they happened to take the public fancy. Very high prices were paid for a single bulb, and speculation in bulbs became the order of the day. A hyacinth mania similar to the tulip mania of 1635-1637 threatened to develop, but the government stepped in and had the laws and orders respecting that mania reprinted and made public, with the result that the fever subsided and wild speculation in bulbs ceased.

Area in which Hyacinth Bulbs are raised.—Just behind the narrow ridge of undulating sand dunes, covered with marram grass, which serve to protect the mainland from the ravages of the North Sea, is the area where bulbs are raised. At one time there were several ridges of sand dunes bordering the coast, but recently, on account of the increased acreage laid down to bulbs, the more inland ridges have been brought into cultivation. Commencing at Scheveningen, on the coast, where small patches of bulbs may be seen, and travelling north, this area is seen to stretch inland a distance of from four to five miles in the neighbourhood of Leyden, Sassenheim and Lisse, ultimately terminating, in much the same way as it began, in the vicinity of Alkmaar. It is this long narrow district, laid out like huge gardens, each edged in with beech and thuya to protect the growing plants from cold winds, and with Haarlem as geographical centre, which is the bulb-raising district of Holland. Hyacinths are not raised in every part of that bulb-growing area, for the soil is not everywhere suitable. It is only in the relatively small area covering a few square miles

with Lisse as centre, and in isolated patches near the coast, that the nature and depth of the soil are remarkably suitable for that purpose.

Nature of Hyacinth Soil.—All soil in this area is sand, blown about by every puff of wind, and its value for raising bulbs depends on (1) its depth, (2) the texture of the sand, and (3) the amount and fineness of the particles of lime which it contains. Experience has proved that this sand must be at least five feet deep to be of any real use for hyacinth growing. A subsoil of a different nature, which is common in the non-hyacinth growing areas, renders it useless for that purpose. The finer the texture of the sand the more suitable it is. Lime is an important ingredient of any soil in which bulbs are grown. Its amount and the fineness of its particles, the latter securing a thorough admixture of the lime with the sand, are important factors. In good hyacinth land the percentage of lime is relatively high, and increases in amount from the surface to the subsoil.

Chemical Composition of Hyacinth Land.—Below are tables showing the percentage chemical composition of good hyacinth land in the hyacinth-growing areas. Sand (silica) is, of course, not stated. In the course of time the manurial ingredients are used up and are replenished by natural and artificial manures.

FIRST CLASS HYACINTH LAND (LISSE)	Nitrogen as N	Phosphate as P_2O_5	Potash as K_2O	Lime as CaO	Humus
1st Foot	0 035	0 09	0 04	0 64	1·20
Subsoil	0 005	0 04	0 02	3 84	0·70
FIRST-CLASS HYACINTH LAND (after 20 years' cultivation)					
1st foot	0 04	0 07	0 04	1·34	1 20
Subsoil	0 01	0 05	0 03	2·96	0·50
SECOND-CLASS HYACINTH LAND					
1st foot	0·45	0 08	0 02	0·10	1·25
Subsoil	0 01	0·04	0 03	0·08	0 50

Temperature and Rainfall.—Of less importance for hyacinths are temperature and rainfall. The average temperature and rainfall per month, covering several years, in Lisse and Katwijk, comparing the same months in different years, show that there are large variations, similar to what commonly obtains in England.

Preparation of Soil for Hyacinths.—After having ascertained, by deep digging, that the nature and depth of the soil are suitable for growing hyacinths, the next important considera-

tion is the supply of water. Hyacinths, as everyone knows who has grown them in water, produce very long roots, and are most at home when the soil in which the bulbs lie is dry, and the tips of their roots are in slowly moving water. Stagnant water is inimical to bulb growing. The Dutch grower has specialised on that important fact, and suitable conditions have been brought about by a combination of the necessary drainage system with a general and uniform level of all the hyacinth-raising fields. If the surface of new suitable land is above the general level, then the excess of soil is removed. If the selected land is below the general level new soil is added. In one case a firm was engaged in removing soil, five yards deep over 700 acres which was covered with pines, yews, &c., so as to bring the surface of the prospective bulb fields to the required level. It is necessary also to commence growing hyacinths in virgin soil. In those cases where it is essential to adjust the level of the land, virgin soil forms the top layer, and the surface layer of new suitable land, which is on the required level but which is covered with vegetation, is placed three feet deep and the underlying soil put in its place.

As all the sandy soil in this bulb-growing area is below sea level, it has had to be drained to render it fit for cultivation. In the hyacinth-growing areas, there is a drain 1½ ft. wide every 800 to 1,000 sq. yd., in which water is kept by the working of the drainage machinery, similar to that in the Fens of England, at a uniform level of 2 ft. from the surface. These drains ramify throughout the bulb fields like blood capillaries through animal tissue, anastomosing with each other to form dykes, and those again to form canals, while the central *vis a tergo* is the drainage machinery. The maintenance of this constant water level in the drains throughout the year is one of the fundamental necessities for the successful raising of hyacinth bulbs. As the sandy soil is porous, and the surface of the hyacinth beds is on one plane, water percolates through the bulb fields at a distance of two feet from the surface, and at the same time rises to the surface by capillary action and passes off as water vapour. Thus by putting one's hand into the soil the surface layer feels dry ; below, the soil is damp, and the deeper one gets the more water it contains.

The effect of rainfall in this connection is interesting and somewhat important, as it leads to the formation of drains 1 ft. deep which empty into the 2 ft. drains, and which serve to remove the excess water after a fall of rain. During dry weather water is continually rising from the subsoil and

passing off as water vapour, but when the humidity of the atmosphere is great, as just before and during rain, then that action is stopped and the soil is soon saturated with water. If rain falls it is necessary to remove the excess, hence the 1 ft. drains.

Crops grown before Hyacinths.—When suitable virgin land at the required level has been secured, and properly drained, the soil is thoroughly dug with the spade; and cow manure, the transport of which is facilitated by the canals, is added at the rate of twenty tons per acre. As a general rule the first crop obtained is potatoes, not only for the value of the crop itself but to stimulate an increase in the soil bacteria necessary for plant growth. Occasionally, instead of potatoes, peas or beans may be planted. After that crop has been lifted, tulips are planted. After lifting the tulips, the ground is again heavily manured with cow manure and this is dug into the soil. Hyacinths follow and are planted early in October. After that the rotation is tulips, narcissus and hyacinths, but, by deep trenching and suitable manuring, hyacinths may be grown year after year on the same soil.

General Cultivation of Hyacinths.—Before hyacinths are planted, the soil should receive a heavy dressing of well-rotted cow manure, usually about twenty tons per acre. Hyacinth bulbs are planted in beds, 1 yd. by 12 yd. in size, and the beds are separated by paths 1 ft. wide. The depth and distance of planting varies with the size of the bulb. Large bulbs are planted 4 in. deep and 5 in. apart, but smaller bulbs are planted closer together and not so deeply. After planting, the beds are covered with reeds or straw, partly to protect the bulbs from severe frosts and partly to prevent the soil from being blown about and laying bare the bulbs. When the foliage appears above the ground the reed or straw covering is removed and the plants receive a top dressing of ammonium nitrate to encourage the growth of the foliage. Following very wet winters, when the manurial ingredients of the cow manure have been partially lost through rain, a further dressing is applied in spring. By a continual use of the hoe the beds are kept free from weeds. When the flowers appear they are removed by running the flower stalk between the fingers, and are either scattered on the ground to prevent the soil from drifting into heaps or sent to a perfumery in Amsterdam. Only the bells of the flowers are removed, for growers realise that flowering, and particularly seeding, reduces the vigour

of the bulb, while the foliage with the green flower stalk and active roots build up solid bulbs. In May, peas or beans are planted in the paths mainly to prevent the soil from being blown about. Bulbs are lifted by hand in June after the foliage has completely died away, and as a uniform size was planted there is little variation in the size of the lifted bulbs, but, if necessary, grading for size is done when the bulbs are lifted. As the bulbs are grown in sand, it is not necessary to clean them by riddling. The period immediately after lifting is a critical time for all bulbs. It is essential that they should be dried at once. Hyacinth bulbs are thus put in trays and placed in a dark store, and if ordinary atmospheric conditions are not suitable for quick drying the temperature is raised by artificial means. The treatment after drying varies with the object in view.

Treatment of Bulbs.—Lifted bulbs may be divided into two classes:—(1) large bulbs which are ready to sell for flower production, and (2) smaller bulbs which are to be grown on for another year or two so as to produce the large bulbs. A small proportion of the large bulbs are selected for the reproduction of the stock, while the rest are graded for size and are marketed. Bulbs which are to be grown on for another season or two, and the large saleable bulbs which are destined to appear on the market as prepared bulbs for Christmas flowering, receive a special treatment which has its basis in a knowledge of the conditions governing the growth of the embryonic flowering bud in the bulb. Under ordinary conditions in the Dutch hyacinth, and in its wild ancestor also, the foliage dies away in June, and the bulbs undergo a period of "rest" during the warm summer months. In reality, however, this is not a period of rest but the time during which the rudiments of the next year's flower now in the bulb is developing and growing. After this flowering bud reaches a certain size, its continued growth is dependent on a gradual fall in temperature together with an increased water supply, and this stage is normally reached about planting time. Thus, by subjecting bulbs to a heat treatment in the month of July, it is possible to concentrate all those summer changes, which result in the growth of the flowering bud, into about three weeks, after which time the flowering bud is in that advanced condition of growth which under ordinary conditions would only be arrived at by planting time. Such bulbs are then known and sold as "specially prepared for Christmas flowering," and it is obvious that, to

obtain flowers by that date, such bulbs should be planted at once and placed under conditions resembling winter. The accompanying diagrams are illustrative of the growth of the flowering bud. Large bulbs are always selected for the Christmas flowering treatment. They are placed in trays and put in a semi-dark store. About the middle of July the temperature of the store is gradually raised in three days from normal to 75° F., and the bulbs are kept at that temperature night and day for three weeks. Afterwards the temperature is gradually dropped to normal. Certain varieties of hyacinths, such as L'Innocence, Christmas White, General Pelissier, &c., which normally flower earlier than the other varieties, respond more readily to this heat treatment, and the temperature in such cases may be raised as high as 80° F. As one might expect, this heat treatment reduces the quantity of water in the bulbs, which largely accounts for the fact that 1st and 2nd grade "specially prepared bulbs for Christmas flowering," of any variety, are never as large as those of the same grade and variety which have not been treated.

The smaller bulbs also contain a rudimentary flower bud, but as the spike only carries a few bells the bulbs are not marketable for flower production. Such bulbs have to be grown on for another year or two so as to produce a larger bulb which will bear a good spike of flowers. These small bulbs are left in trays in a dark store until September. By that time their flowering bud has reached that stage when a gradual fall in temperature is most favourable to its continued growth. If the bulbs are then heated for several weeks commencing about the middle of September the growth of the flowering bud is inhibited and after planting the flowers are later in appearing. This means that the vegetative period during which the bulbs grow is lengthened, and if such bulbs, after planting, are encouraged to produce foliage by the addition of a nitrate manure to the soil, the vegetative period is still further lengthened. By making use of those two facts the time taken in raising flowering bulbs for the market is nowadays shortened by one year. About the middle of September, the temperature of the dark room in which these bulbs are stored is raised in three days from normal to 70° F. and that temperature is maintained day and night for a month. The temperature is then gradually dropped to normal and the bulbs are planted at once.

Propagation of Hyacinths.—(1) *By sexual means.*—There is really no occasion for a grower to adopt this method unless

he is desirous of raising new varieties, for the procedure is long and tedious. It consists in the transfer of pollen to the stigma of the flower, thus raising seed ; the planting of that seed, thus raising small bulbs ; and the continued growing of these bulbs until a flowering bulb is produced.

(2) *By vegetative means.*—A comparatively easy method of reproducing the stock is to wait for naturally formed offsets which can be grown on till they become flowering-sized bulbs. This method is very slow, for offsets are rarely produced. The commercial grower makes use of artificial means to increase his stock. The two methods in common practice are (*a*) cutting and (*b*) scooping.

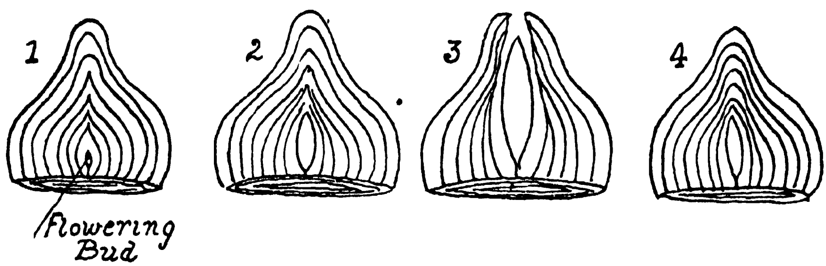

FIG. 1.—Development of the Hyacinth Bulb.

1. The Flowering Bud when the Bulb is lifted in June.
2. The Flowering Bud at the end of September. (Growth during summer months.)
3. The Flowering Bud at the middle of February. (Continued growth during winter months.)
4. The Flowering Bud at the end of July, after treatment for Christmas flowering. (Compare with 2.)

(*a*) The method of *cutting* consists in taking a first-sized bulb in June, and with a knife making two or more cuts in the base about ½ in. deep equidistant from each other. The bulbs are then planted for fourteen days. This is done so that the cut surfaces may heal, and to prevent damage from mould (*Penicillium*). After that time the bulbs are lifted and put in trays in a dark store and kept at a temperature of 70 to 80° F. until September, when the temperature is reduced to normal. For the first three weeks nothing is done except to keep the temperature up. Then the floor and the bulbs are sprinkled with water every morning. As much ventilation is allowed as is compatible with the maintenance of that temperature. All this is done to stimulate the growth of the buds in the axils of the fleshy leaves of the bulb ; and, by careful attention, those buds, before planting time, will progress so far as to resemble small bulbs. In September the cut bulb, with its buds *in situ*, is planted, and each one of the buds sends one or more leaves

above the surface. On lifting in the next spring, the planted bulb has shrunk to nothing more or less than scales, and, in its place, are twenty-five to thirty bulbs well on the road to becoming flowering bulbs. These bulbs are lifted by hand, graded for size, dried and then stored in a dark warehouse. In September, as already stated, they are heated and then planted.

(b) *Scooping.*—It is said that this method of increasing the stock was discovered by finding new small bulbs in the cavities of bulbs which had been nibbled by mice during storage. Whether this is so or not, that nibbling principle is made use of in scooping. Large bulbs are selected in June, and with a curved knife a cup-shaped cavity $\frac{3}{4}$ in. deep is cut out of the base of the bulb. The bulbs are then treated as if they had been cut. There is this difference between the two methods. In cutting, the buds at the base of the fleshy leaves of the bulbs are stimulated to grow, but in scooping those buds are removed, and adventitious buds are produced on the cut surface of the fleshy leaves of the bulb. Consequently there are a larger number of adventitious buds produced—forty to fifty—but they are smaller than the normal buds, and take one or two years longer to grow to the size of a marketable flowering bulb. In short, by cutting, the stock can be increased twenty-five to thirty-fold in two to three years; by scooping the stock can be increased forty to fifty-fold; but it takes four years. The method used depends on the variety and on the prevalence of disease.

It will readily be understood that all varieties may be propagated by the method of cutting, for in that case buds normally present are stimulated to grow. It is, however, not always wise to follow this method, since it is only by scooping that one can make sure bulbs are free from a disease called "Yellow Disease." On the other hand, not all varieties will yield to the drastic treatment of scooping. Sometimes high susceptibility to the disease mentioned, and inability of the bulb to yield to scooping, are both characteristic of one variety, in which case there is danger of losing the stock.

Diseases of Hyacinths.—*Yellow Disease.*—The most common and, consequently, the most menacing disease, is that named "Yellow Disease." This is due to a bacterium called *Pseudomonas hyacinthi*. The symptoms of the disease can be seen in the foliage. The leaves develop narrow dark stripes near and parallel to the edge. These dark stripes arise through the vascular bundles being choked with bacteria. The bacteria

also affect the base of the bulb. The early stage of infection can only be discovered by scooping bulbs. Infected bulbs when cut show yellow spots where the vascular bundles lie, and badly affected bulbs go soft and rotten. Fortunately, this disease does not infect the soil; the bacteria are spread by air. There is no known cure for the disease, and thus the control method employed is that of eradication. Growers constantly examine their beds of bulbs during the growing season and also the bulbs when scooped. Diseased bulbs are destroyed, and, immediately diseased plants are found in the beds, the entire plant with the adjoining soil (so as to ensure inclusion of every part of the diseased plant) is removed and destroyed. Some varieties, including L'Innocence, Grandesse, King of the Blues, and Grand Lilac are more susceptible to "Yellow Disease" than others.

Ring Disease.—This disease is due to the eelworm, *Tylenchus hyacinthi*. Dr. van Slogteren, of the Pathological School, Lisse, has shown by elaborate experiments that this eelworm is not the same as that which attacks narcissus, nor are the two eelworms interchangeable, each being confined to its particular host. The symptoms of the disease are similar to the symptoms of eelworm in narcissus bulbs, and may also be seen in the foliage, and this eelworm, too, contaminates the soil. Diseased plants and the surrounding soil are removed and destroyed. Hyacinth bulbs are also sterilised in just the same way, both in principle and in detail, as diseased narcissus bulbs. Dr. van Slogteren has recently been working to ascertain the best time for sterilising diseased hyacinth and narcissus bulbs by the hot water treatment, and his investigations show this to be about the middle of August. The temperature used in sterilising is, of course, more than 30° F. higher than that used to hasten or retard flowering, and this high temperature has its effect on the growing flower bud within the bulb; as sterilisation if done very early, *i.e.*, soon after lifting, may kill the embryonic flower bud. If sterilisation is carried out late in the season, the heat not only has the effect of delaying flowering, but unhinges the correlative growth of the flower, delaying one part more than another, with the result that split bloom may be obtained. The English narcissus grower often has split bloom through sterilising too late in the year. Further, early in August, which is the best time to sterilise without detrimental effect, is the time when the developing flower bud requires heat for its growth, so that the high temperature of sterilisation then has the least adverse effect.

"*Fire.*"—This disease is due to a fungus (*Botrytis* sp.) similar to that causing "Fire" in tulips. The two species are, however, quite distinct, and each is confined to its own host. Hyacinths in Holland are apt to suffer from late frosts which kill the tips of their leaves. If favourable weather follows damage to foliage, *Botrytis* appears and may destroy the leaves, thus preventing further growth of the bulb. *Botrytis* sp. does not form black sclerotia on the bulbs as is the case with tulips. This *Botrytis* disease, however, is not specific to hyacinths, and it is doubtful whether the method in practice of spraying with Bordeaux mixture is of any use.

"*Maladie.*"—Another disease, not very prevalent, but common to hyacinths, narcissus, and tulips, is one, which having passed through the hands of the Bacteriologist and the Entomologist, is now thought to have found its proper place in the Mycological section, but so far the causative fungus has not been isolated. On lifting, the root system is seen to be reduced in length. The terminal 2 in. of the roots are brown and dead, and dead patches $\frac{3}{4}$ in. long may be seen in the remaining portions of the roots. This disease contaminates the soil, but it has been found that a solution of formaldehyde kills the organism, and healthy plants may be grown on such land after treatment.

Degeneration.—In common with the leading opinion on degeneration, it is thought that hyacinths suffer in this respect. No work has been done towards isolating any virus, but it is known that certain varieties have degenerated and that others are degenerating.

In conclusion, the writer desires to acknowledge his indebtedness to Dr. van Slogteren, for the explanation of his experiments on the sterilisation of Hyacinth and Narcissus bulbs which were displayed at the International Show at Haarlem in April, 1925; also to Dr. Volkersz, Principal of the Bulb School, Lisse, for the data on the rainfall and composition of the soil in the bulb-growing area of Holland.

THE NATURAL HEALING OF WOUNDS ON TREES

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WHEN a potato tuber is cut through, natural processes at work soon render the cut surface relatively safe from the attacks of organisms producing disease or decay. These processes were

discussed recently in this Journal*, and it was shown that certain conclusions of practical significance emerge, as to the conditions to observe when planting cut potato sets.

From this standpoint it seemed desirable to re-examine the natural process of healing that gradually builds up a protective barrier at the exposed surface of a woody branch, when this is either cut or broken across. The examination was undertaken by Mr. T. Swarbrick, of the Botanical Department at Leeds. His main results are published in the *Journal of Pomology*†, but possibly a brief and less technical account may have some value, as these results certainly seem to have considerable bearing upon practice.

At the outset it may be well to emphasize the difference between the condition of the cut surfaces of the potato tuber and the woody branch. The whole exposed surface of the tuber consists of an almost unbroken layer of living cells, spherical in general shape, upon which is left the débris of walls and contents of the cells actually broken or damaged by the cut. All the living cells are turgid with the water they absorb, and if the surface is exposed to reasonable conditions as to light and moisture, the sap oozing from the living cells along the walls near the cut soon dries and oxidises to a thin but firm coating of fatty varnish, the suberin layer. This layer, which is quite continuous under favourable conditions, is formed within some forty-eight hours, and is a good first line defence against the entry of disease-producing organisms. Below it, through the activity of the numerous living cells, a continuous new skin of regular cork cells forms within, perhaps, another five or six days, and this layer gradually thickens until the cork layer over the cut surface is at least as firm and strong as the normal, corky skin of the tuber.

In the woody stem, on the other hand, a cut exposes a certain proportion of living cells, but all through the wood of the plant these are interspersed with microscopic wooden pipes and fibres, full perhaps of sap but containing no living substance ; towards the centre of the wood the proportion of such non-living elements increases, towards the outside of the wood more living cells proportionately are present.

Outside the wood is a thin ring of bast in which dead fibres may also be present, and between bast and bark is a very thin

* This *Journal*, February, 1925.

† *Journal of Pomology and Horticultural Science*, Vol. V, pp. 98-114 1926.

layer of living cells, the cortex, similar in type to those which form an almost unbroken layer across the cut tuber.

Probably when the surface of the woody stem is exposed, the reaction of the scattered living cells present is of the same nature as in the potato tuber ; but the sap exuding from these comparatively few cells does not suffice to form a layer of fatty varnish completely across the cut surface, though it may form across the thin ring of cortex. Just below the cut surface of the cortex, a layer of cork may then be formed, but since cork cells can only be formed from living cells, no such layer can form across the wide expanse of exposed wood in which the broken ends of fibres and pipes, empty of living contents, are present. Wood and bast in the normal stem increase in amount each year through the activity of a layer of living cells, which lies between them and which continues to divide in the growing season, adding new elements to the outside of the existing ring of wood, and to the inside of the existing layer of bast. This living tissue, the cambium, remains active just below the cut surface ; and as the result of its activity a ring of new tissue appears on the cut branch, gradually broadening outwards and inwards, until in time it creeps over the whole of the exposed surface, burying the broken ends of pipes, etc., under a smooth continuous living tissue. Near the upper surface of this smooth mass of healing tissue, the callus, a layer of living cells becomes active in cutting off a regular cork tissue and thus, *in time*, if a disease-producing organism has not entered the branch meanwhile, the latter will be healed by a smooth impervious cork layer, as continuous and resistant as that present in the normal bark.

Time, however, is the dominant factor, for while in the case of the potato tuber the new cork layer is formed in a week or so, in the cut tree branch the layer of callus, in which the cork subsequently forms, may take years to spread from the cambium until it completely covers a large wound. If this were the only protection present in the branch against disease, then, long before the callus could form, wound parasites, if present, would be carrying disease into the tissues of the tree. Mr. Swarbrick's observations, therefore, were directed particularly to the happenings at the cut surface of the wood within the first few weeks or months after cutting, branches from four to six years old being cut in each month of the year, and the tissues below such a cut examined in samples taken every subsequent month. Hence the progress of the changes

occurring at the wounds made in a particular month could be followed throughout the year.

Observations were made in this way upon sycamore, rhododendron, plum and apple. There is no need, however, to discuss here the behaviour of individual species of trees, because there is little doubt that the general conclusions arrived at hold good for all trees in this country. In so far, however, as seasonal events are under discussion, it must be remembered that the work was carried out in Yorkshire. This is important, because one of the main results of this work is the difference in behaviour of surfaces exposed by cuts made in May, June, July and August, as compared with those exposed in September and October, and still more with those cut during the winter months from November to April.

Natural Healing in Early Summer.—When a woody surface is exposed in the summer months (May to August), the sequence of changes at the surface is very rapid. At the cut surface of the wood, amongst the myriads of thin pipes and fibres with woody walls, which run lengthwise in the wood and are exposed and often broken across by the cut, there are a certain number of living cells which are usually full of starch. Long lines of such living cells, the pith—or medullary—rays, also radiate through the wood running from near the centre to the periphery; all the cells of these rays are also full of starch. The living cells immediately at the cut surface are probably killed, and beyond a gradual discolouration undergo no visible change, while, eighteen months later, they still retain their starch. But just below the exposed surfaces a rapid change takes place, and within ten days the starch is visibly disappearing from the living cells; and through a depth which extends from $\frac{1}{8}$ to $\frac{5}{8}$ of an inch below the cut surface, the starch has completely disappeared within two to four weeks after the first exposure of the surface.

At the same time other substances are appearing in these cells. In the living cells in the young wood and the bast, a pale yellow viscous substance appears, and at the same time this, or a similar substance, is also forming in the empty vessels and fibres. There can be little doubt that this substance is produced at the expense of the starch; it is formed, therefore, in the living cells, and from them diffuses into the cavities of the vessels and fibres. In the living cells of the inner part of the wood and the pith, the starch is replaced by colourless refractive globules.

These two substances are probably not identical. The viscous amorphous material is undoubtedly the substance usually termed "wound gum," and this name will be adopted, with the proviso, however, that, from its reactions, it certainly does not belong to the chemical category of gums.

The refractive globules appear in those tissues where resins most readily appear, either with age or, precociously, as the result of injury; they are probably allied to the resinous substances formed in such tissues though, again, their micro-chemical behaviour forbids their identification as resins.

The important point about the chemical reactions of both substances is their great resistance to all types of reagents; they are dissolved or disintegrated by either strongly alkaline or acid hot oxidising agents, but they resist all other types of solvents, and undoubtedly would resist the powers of penetration possessed by fungus parasites.

Within a period of from ten days to four weeks, therefore, all the starch in the first half-inch or so below the wound is replaced by viscous masses or resistant globules, which not only fill the living cells, but gradually plug up the cavities of all wood fibres and vessels. The result will be a gradual blocking of the cut surface against loss by evaporation and against entry of disease organisms, a blocking which is much more effective in regard to its time of production than the later protection afforded by the ingrowing mass of callus. It is very difficult to be certain by microscopic examination that the block across the cut surface is complete. Mr. Swarbrick, however, has devised a simple experimental test which enables a rapid determination to be made of the extent to which the cut surface is so blocked.

A piece of a branch including the old cut surface is inserted air-tight through a rubber stopper into an inverted filter-flask as in Fig. 1. The old cut surface is then submerged below the surface of an alcoholic solution of safranin dye, whilst the filter-flask is attached to an exhaust pump. If the wounded surface has recently been cut, the dye will have been sucked up into and throughout the few inches of the stump within two minutes. With branches examined a month after the original cut was made, it was almost impossible to draw any dye into or through the tissue, whilst within two months a suction of 70 mm. of mercury, applied continuously for 36 hours, completely failed to draw dye into the branch through the blocked surface.

Natural Healing in the Late Summer or in Winter.—With wounds made during September and October, the main difference observed is that starch disappearance within the first month or two, though considerable, is not complete. The production of viscous wound gum is naturally less copious, the plugs form more slowly in the cavities of vessels and fibres and, as a result, the blocking of the cut surface is not complete. In the following May, when the sap is once more rising in the trees, the starch completely disappears from the half inch below the block, copious wound gum production is associated with its disappearance, and the cut branch becomes completely blocked.

In wounds made during the dormant season, November until April, with the exception of the April wound, starch disappearance is negligible in amount, a certain amount of "wound gum" is formed in the living cells, and isolated vessels and fibres are plugged with the gum in the vicinity of the wound.

Nothing approaching complete blocking occurs, however, and, all through the winter months, trial of the cut surface with the apparatus previously described will show that the dye can readily be drawn through the cut by quite a small amount of suction. In May again, starch disappearance proceeds rapidly underneath all the winter-made cuts, and within some four to six weeks after the commencement of such starch disappearance the cut surface becomes completely blocked.

Relation of the Block to the Entry of Disease-producing Organisms.—Frequently, throughout these observations, fungus spores, or the fungus threads developing from the spores, were found in the dead cells and wood elements in the neighbourhood of the cut surface, though fungus invasion was the exception rather than the rule, particularly with sycamore and rhododendron. In no case have these fungus hyphae been found penetrating beyond a blocked region. In many cases the cut branches seemed to be completely free from fungi, and evidently "wound gum" production must be regarded as a natural reaction of the healthy tissue to the wound, not the result of its stimulation by parasitic organisms.

Cut wood surfaces have frequently to be exposed to the action of disease organisms, as in the practice of pruning, and it is not always possible to use antiseptic dressings upon the cut surfaces, whilst such dressings may often bring their own

disadvantages in their train. It is, therefore, of considerable significance to find that the effective blocking of the exposed tissues against the entry of organisms carrying disease, takes place in so short a time in the case of cuts exposed in the late spring or early summer. This is in striking agreement with the observations of F. T. Brooks and W. C. Moore,* who has found that the months of June, July and August are those in which infection with Silver Leaf, a disease caused by one of the most virulent of wound parasites, occurs least readily or not at all.

The natural healing of the exposed surface is, of course, only one factor to be considered in choosing the time for pruning, others are the habits of the most prevalent wound parasites, the cultural purposes for which the cut has to be made, the availability of labour, and so on. In so far, however, as this particular factor can be considered in practice, the rapidity of the first stages of natural healing during the late spring and early summer months, argues strongly in favour of carrying out such operations as pruning during these months.

THE INFLUENCE OF WINTER AND LATE SUMMER EGG PRODUCTION ON PROFIT

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THREE sets of figures, which have come into the writer's possession from different sources, afford an opportunity for comparing the results obtained from average egg producers with those derived from well-fed and capably-managed flocks. In the following notes are set down certain deductions arrived at after analysing the figures in question, which relate to :—

(1) The weekly collections from and prices paid to members by the Stamford and District Co-operative Egg and Poultry Society, Ltd., for the year September 6, 1924, to September 5, 1925. These figures cover a total of 1,541,000 eggs collected in a nine-mile radius from Stamford (Lincs.) from all classes of egg producers. The number of hens producing this total is not known, but, for the purpose of this comparison, the figure is treated here as an example of average countryside egg production.

(2) The weekly output and prices from a flock of 131 pullets at the Midland Agricultural and Dairy College. These figures are from October 1, 1924, to September 30, 1925. The flock average was 190 eggs per bird.

(3) The figures for production from the Nottinghamshire County Egg-laying Trials, October 16, 1924, to September 15, 1925. The flock average was 156 eggs per bird.

* F. T. Brooks and W. C. Moore: Silver Leaf Disease, V, *Journal of Pomology and Horticultural Science*, V, No. 2, March, 1926.

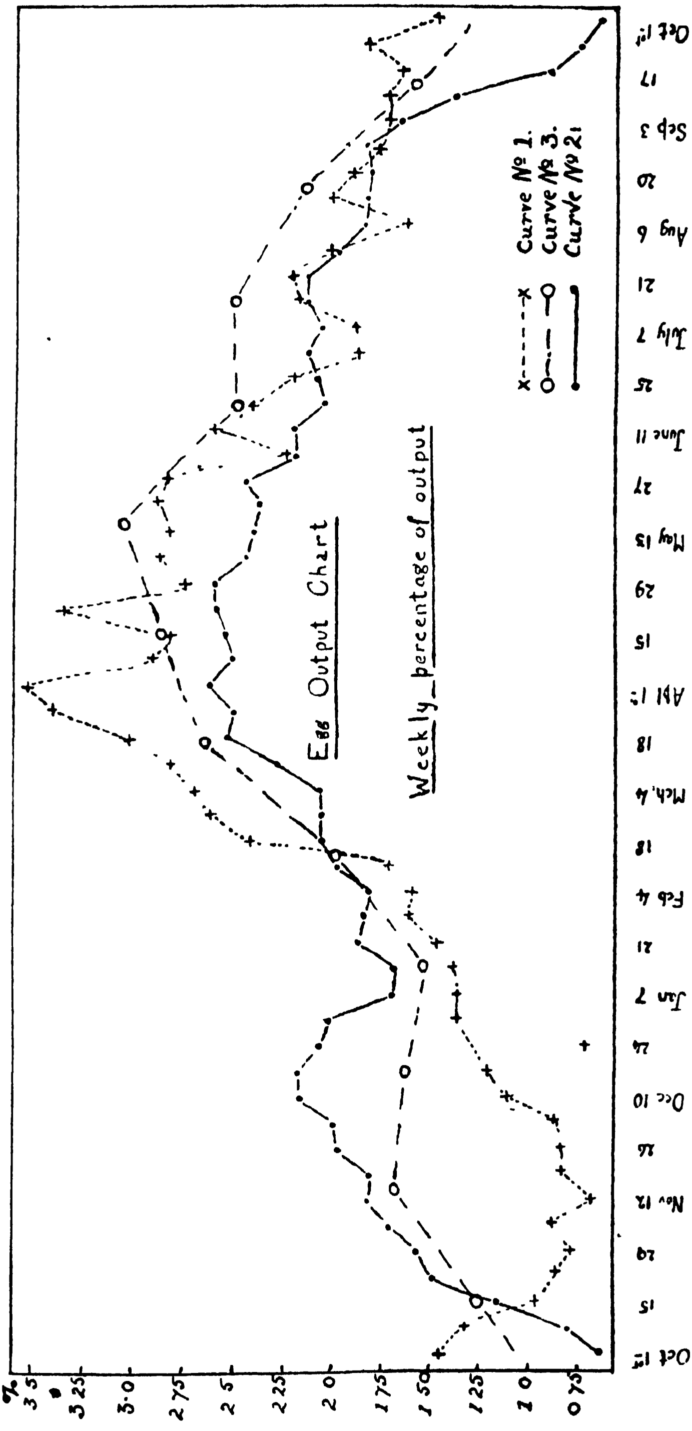

FIG. 1.—Egg Output.

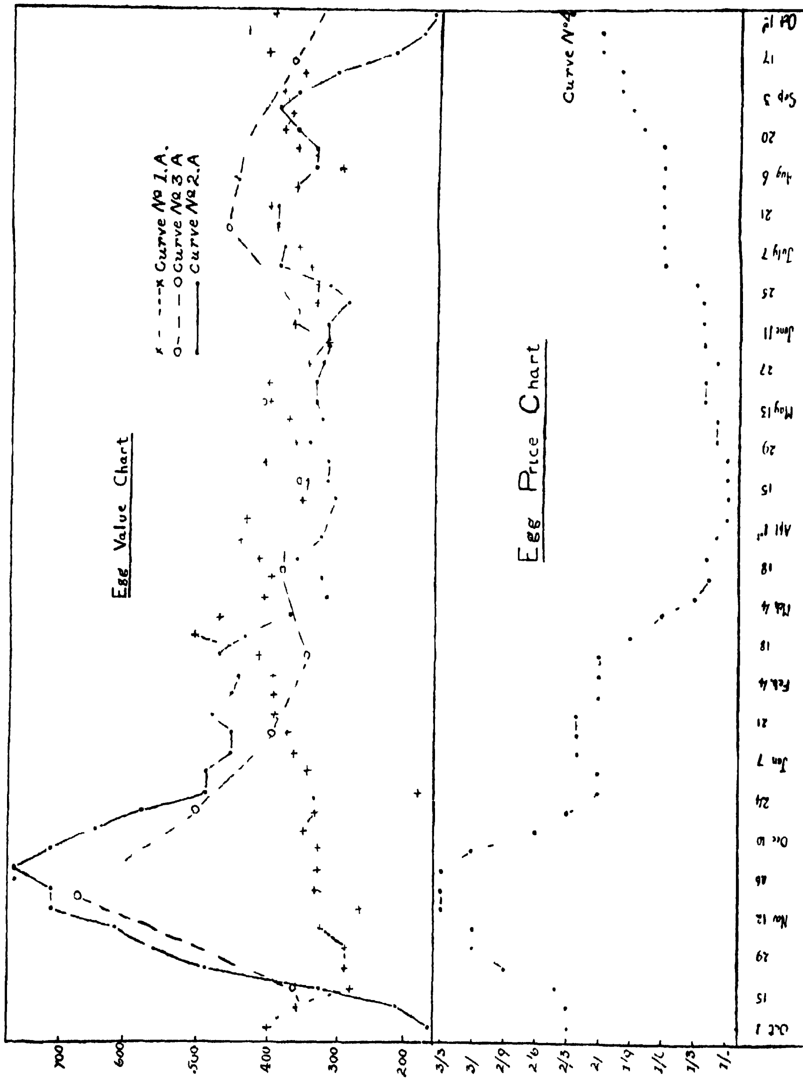

FIG. 2.—Top.

FIG. 3.—Bottom.

The first step in analysing these figures was to plot the production curves on a common standard. To do this the weekly output of eggs in each case has been reduced to a percentage of the total output for the year. The resulting curves are shown on Fig. 1—"Egg Output"—from which it will be noted that:—

Curve No. 1 (The Stamford Society) shows a steady rise from mid-November to the peak of spring production in early April, and a fall to the lowest point of production in the following November.

Curve No. 2 (Midland College) shows a steady rise to a high peak of winter production in December; a moderate drop in January; another steady rise to the peak of maximum production in April; then a steady fall to the end of August, followed by a rapid decline to the end of September.

Curve No. 3 (Notts County Laying Test) shows a much less pronounced peak of winter production in November; a slight drop until January 7; then a steady rise until May, followed by a steady drop until the end of September.

Comparing these curves, it will be seen that No. 2 shows the best winter average and No. 1 the worst. The former rises, in fact, to 80 per cent. of the summer maximum production. The spring average is highest in the case of No. 1 and lowest in the case of No. 2. The late summer average is much better with No. 3 than with either of the others.

For the purpose of comparing the values of these egg outputs, one set of price figures only has been used, this comprising the prices paid by the Stamford Society to producers. These prices have been plotted on Fig. 2 as Curve No. 4. This curve comes out as an exact reverse of the Stamford production curve (No. 1), having the high peak of price in November with a step-like rise and fall to and from the lowest price level in April. This, in itself, is an indication that the figures represent a fairly average production, as the period of maximum production should coincide with the period of lowest price.

By combining the price figures with the output figures we obtain on Fig. 3 the value curves, No. 1a (Stamford), No. 2a (Midland), and No. 3a (Notts Trial), and from them certain definite conclusions may be deduced. Curve No. 1a has become almost flat, showing that eggs from a countryside collection of this kind conform too closely to the law of supply and demand and give a balance in value of output throughout the year. From this, it would appear that the general country egg supply still sets the market price.

In Curve No. 2a, the peak of production in December is rather late, as the peak in price occurred in November; the

result is that the peak in value is not as high as it might have been. After the middle of February, this value curve kept steadily below both the others. In Curve No. 3a, the peaks of production and prices were coincident. The result is shown in a relatively better peak of value for winter production than in No. 2a The better late-summer production, coupled with a rising price, resulted in a well-defined peak of value in July and August, combining to raise the average value of the eggs in this case to a higher figure than the flock average would lead one to expect

The average price of eggs throughout the year in these three cases, based on the same set of weekly price figures, works out as follows :—

	s	d	
Stamford Society	1	6½	per doz.
Notts Laying Trials	1	9½	per doz.
Midland College	1	10¼	per doz

The differences are entirely due to the seasonal variation in production, showing that, with the same output of eggs, it was possible for a producer, by getting the peaks of production and price to coincide, to average as much as 3¾d. more per doz. for his eggs throughout the year, although paid at the same weekly prices as his competitors.

As further deductions from these charts, it would seem that, to obtain the best results from egg production :—

(1) It is essential to make the peak of winter production coincide with that of price ; and that one should aim for the maximum winter production in November rather than December.

(2) Production in July, August and September is a very decisive factor in determining the average value of the year's output

(3) The value for the average countryside collection of eggs approximates very closely to the straight line which denotes the balance of supply and demand ; and from this it may be inferred that the "casual" egg still controls the market price

A further interesting point emerging from this analysis is that, comparing the actual prices received by the producer in Stamford and at the Dairy College, the actual weekly difference is shown to be 2¾d. per doz. in favour of the latter. The actual cost of the Stamford Society for collecting and marketing was, approximately, 2½d. per doz., so the area prices show a very close agreement, confirming the apparent difference as being due to the seasonal variation.

NOTES ON THE STEM EELWORM

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Introduction.—Plant parasitic Nematodes, or eelworms, are minute colourless worms, rarely large enough to be distinguishable by the naked eye. Reproduction takes place by means of eggs. These eggs hatch into small larvae, very similar in appearance to the adults except in the matter of size. Several moults take place before the worms are fully grown, the whole process occupying from several weeks under favourable conditions, to several years if conditions become adverse during part of the process. The greater part of the active life of these worms is spent in or on plants, to which they often do considerable damage.

The particular eelworm under discussion, *Tylenchus dipsaci*, Kuhn, is commonly known as the stem eelworm, by reason of the fact that it usually confines its attacks to the stems and leaves of plants and is never known to enter the roots. It is responsible for injury to a variety of both wild and cultivated plants, and is known as a severe pest of crops in most of the temperate regions of the world.

Symptoms of Attack.—Attacked plants, which on examination are found to contain large numbers of the worms in all stages of development, may as a rule be detected by their unusual appearance. Such plants are, as a whole, dwarfed and distorted, these features being accompanied by a certain amount of swelling and blistering of parts of the plant, notably the softer portions of the stems and leaves. The basal portions of the stems and regions around the growing points are the positions primarily attacked, the eelworms later invading the petioles and leaves. Young plants frequently succumb to the attack, but cereal hosts may often be induced to grow away from such an attack if suitably stimulated, as the eelworms are unable to feed in the plants when the tissues become less succulent. However, even if a crop be saved by this means, it is invariably inferior to one which has escaped infection.

Some Common Host Plants.—The oat is a common host plant and many cases of failure of this crop attributed to the Frit Fly (*Oscinella frit*, Linn.) have, on examination, proved to be due to this eelworm. Other common hosts in this country are clovers, peas and beans, phlox, flower bulbs and onions,

and in recent years, potatoes. In the case of bulbs and onions, the bulb itself is invaded, as also are the stems and leaves, which show the characteristic deformation and dwarfing. The attack on the potato is probably unique, for the tubers only are attacked, the haulm above ground being free and presenting a normal appearance. Bulbs, onions and potatoes may also be attacked while in store.

Life History and Modes of Spread.—The eelworms breed with considerable rapidity when the supply of food is plentiful, but as soon as the attacked plant becomes weakened and less vigorous, numbers leave it and migrate through the soil in search of a fresh host. Others, left in the plant, become dormant as this dries up and remain in the dried remnants until such time as these are subjected to moist conditions, when the eelworms once more become active and leave in search of a fresh supply of food. Before leaving the host, or alternatively becoming quiescent in its dried remains, the eelworms become packed with stored food material. No call is made on this reserve during the resting stage but it is rapidly utilised when the worms are in a state of activity.

There are, therefore, two main sources of infection of a fresh crop. (1) The first consists of those worms which have escaped directly into the soil. These must remain active while in a moist environment, and are unable to feed until they find a fresh host. The length of time during which this enforced starvation can be withstood has not yet been determined, but experiments now in progress point to its being of shorter length than has generally been thought to be the case. (2) The second source comprises those eelworms which remain in a desiccated state in the dead host plant. In this condition they can remain for a period amounting to several years at least. Until the advent of moisture no sign of life is visible and no call is made on the stored food matter. It is seen that infection from this source can take place over a much more extended period than is possible in the case of the previous one. (3) A third mode of infection—in reality an extension of the second—has been found to occur sometimes in the oat. Desiccated eelworms of this species have occasionally been found beneath the husk (pales) of seed taken from badly infested fields. How the worms get to this position has not yet been determined and the small number of cases in which they have been found thus situated suggests that such occurrence is accidental. However, the significance of this fact is obvious, as it introduces the

possibility of infecting ground, hitherto free, by sowing such seed. Careful watch should be kept for any development in this direction, as it has recently been shown in America that seed dissemination is the normal mode of spread where this eelworm occurs on certain other host plants.

The Occurrence of Biologic Strains.—In recent years attention has been drawn to the occurrence of biologic strains in this and other plant parasitic eelworms. Such strains or races of any particular eelworm are identical in appearance with one another, but each one seems to be able to attack freely some particular plant and, at the same time, appears unable or at least unlikely to flourish on other plants. This may be the case even when the plants are well-known hosts of other strains of the same species. For example, a strain feeding on onions would be unlikely to attack potatoes even if no onions were available. Observations made in the field have tended to confirm this view, as may be seen from the few cases quoted below.

Field Observations and Experiments.—*Tylenchus dipsaci* is a serious pest of the strawberry in some parts of America. In certain strawberry areas in this country, narcissus bulb cultivation is also practised, and the two crops have been alternated on the same ground over a number of years. While the eelworm is of common occurrence in the bulbs in this area, no case of attack on strawberry has ever been observed by the writer.

In another bulb area, oats, a well-known host of the eelworm, are frequently grown in the vicinity of infested bulb fields, and even on ground which has just previously carried a heavily infested crop of bulbs. No case of attack on the oats in this area has so far been found, and inquiries indicate that this plant is unknown as a host here. Again, oat crops severely attacked are often followed by a perfectly healthy clover crop, in spite of the fact that certain strains of the worm are capable of severe injury to this plant.

Experiments carried out, and others now in progress, with strains of the eelworm of known history over a period of years, indicate that such biologic strains do indeed exist, but that they do not all show the same degree of rigidity as regards the inability to attack potential alternative host plants. Entry into such plants was frequently effected, the difficulty seeming to consist of an inability to become established once such an entry

has been made. In some cases they were found to disappear from the plants after a few weeks, but in others they persisted for periods extending into months, and in such cases might reasonably be expected to adapt themselves eventually to the new hosts. The ability to transfer from one host to another probably depends very largely on the length of time that one particular host has been utilised, and further experiments now in progress give some indication that this is the case. It is certain that while some strains show a complete inability to transfer from one host to another, others are able to do so to a greater or less degree. These generalised forms do not as a rule cause such severe injury to the plants attacked as do those which have concentrated on the one host. It further seems that the eelworms cannot exist in a state of activity in the soil without food for such an extended period as has been thought to be the case. Information on the subject is by no means yet complete, but the period probably does not exceed a few months.

Discussion.—Certain deductions of practical use may be made from the foregoing notes. It appears that, while, in the case of attack by one strain on a particular host it would be safe to follow with another crop known to be a host of the eelworm, the same would not hold good if it happened to be a generalised form of the pest that was causing the damage. The extent to which such a transfer is likely to occur is governed, to a very large degree, by the time during which the strain has confined its attack to the original host. In cases where information on this point can be obtained—and such cases are by no means as uncommon as might be supposed—the course of action may be determined accordingly. In cases in which the eelworms are known to have been on one particular crop for two or more years, the attack on other potential hosts is likely, at least during the first year, to be so slight as to be negligible. From this it is seen that as a general rule it would be safe to put down clover after, say, an oat crop attacked two years running on the same ground; but, if the clover was destined for a two or three years' ley, it might possibly be seriously attacked towards the end of the period, as the pest became more accustomed to the new host.

The above instance is quoted as it actually occurred on a field under constant observation, and such behaviour may reasonably be expected, irrespective of the host plants concerned.

THE GRADING AND PACKING OF ASPARAGUS IN CALIFORNIA

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Introduction.—By far the largest asparagus-growing area in the world is to be found in the State of California, where the interior, hot valleys of the Sacramento and San Joaquin rivers have been found eminently suited to the large-scale production of this crop. The rich " muck " soil and favourable climate of the Delta region have favoured the development of asparagus growing to a remarkable extent, some 17,000 acres being devoted to this crop in 1919. This area, in recent years, has been enormously increased, one firm alone, the California Packing Corporation, cultivating some 4,500 acres of asparagus, of which they " can " large quantities. Early consignments, representing about 10 per cent. of the total crop, are sent to the middle west and eastern markets. Later on, when asparagus grown in the eastern states makes its appearance in the New York and other eastern markets, the Californian product is canned, large canneries, which deal only with this crop, having been established for the purpose in proximity to the asparagus fields. The various operations and treatments in preparing the fresh material for market may be briefly described as under.

Washing.—As soon as possible after cutting, asparagus for the eastern markets is collected in wooden boxes (about 2 ft. long, 1 ft. 6 in. wide, and 1 ft. deep) and taken, usually by motor, to a central packing station. Here the butt ends of the stalks are doused in tubs of water to remove loose sand, care being taken to avoid, as far as possible, wetting the tips, since moisture on the tips encourages mould growth. (Some growers do not wash the asparagus before bunching, but merely brush the outsides of the bunches before packing.)

Grading.—The stalks are then placed on sloping tables and carefully graded according to diameter, length, and general appearance. The number of grades varies, and depends on the quality of the product (Fig. 1.). Three grades are usual for the fresh market, while no fewer than six are adopted by the canneries. The Los Angeles market, however, demands

loose asparagus, and therefore it is packed ungraded in boxes as shown in Figs. 2 and 3.

The large stalks of the greater diameter, free from blemishes, constitute the best grade, "Colossal"; the medium size stalks, which are straight and of good length, make up the second grade, "Fancy"; and the slender and crooked stalks constitute the third grade, or Prue. The main crop which is available for the asparagus canneries is more carefully graded. Indeed, the grading of all fruit and vegetables intended for preservation purposes is common throughout the United States, and much of the success of the enormous canning industry which has been built up is the result of this practice.

Bunching.—After grading, the stalks are placed in a small machine, Fig. 4,* with the tips against the circular disc shown in the photograph, where they are made up into 1, 2, or 3 lb. bunches as required, small bunches being preferred for the local retail trade. This machine is in general use both in California and New Jersey, and possesses the advantage that its use requires little practice or skill. The grading and bunching of 20 to 25 bunches per hour is considered quick work.

The stalks of asparagus are placed so that the curve of the tips is towards the centre of the bunch, and after the bunch is assembled, the clamp is brought over and a tight bunch is made, Fig. 5. Notches on the clamp enable the latter to be pressed into three different positions depending on the size of the bunch required. Red tape, usually of ¼ in. width, is used to tie the bunches and to give them an attractive appearance, and the butt ends are then evenly cut off with a sharp knife, leaving the stalks 8½ in. to 10 in. long. "Colossal" contains 17 to 25 stalks; "Fancy" averages from 30 to 40 stalks; whilst the Prue may contain all the slender and crooked stalks.

Packing.—The bunches are wrapped in white waterproof paper, on which is printed in bright colours the name of the grower, or the particular brand, and they then form very attractive packages, Figs. 6 and 7.

Several types of box are used in the United States for packing asparagus. The Californian crate, which is admitted to be one of the best, holds twelve 2 lb. bunches, and is 19½ in. long, 10½ in. deep, 11 in. wide at the bottom and 9½ in. wide

* The asparagus bunching machine is being tried in the Evesham district this season.

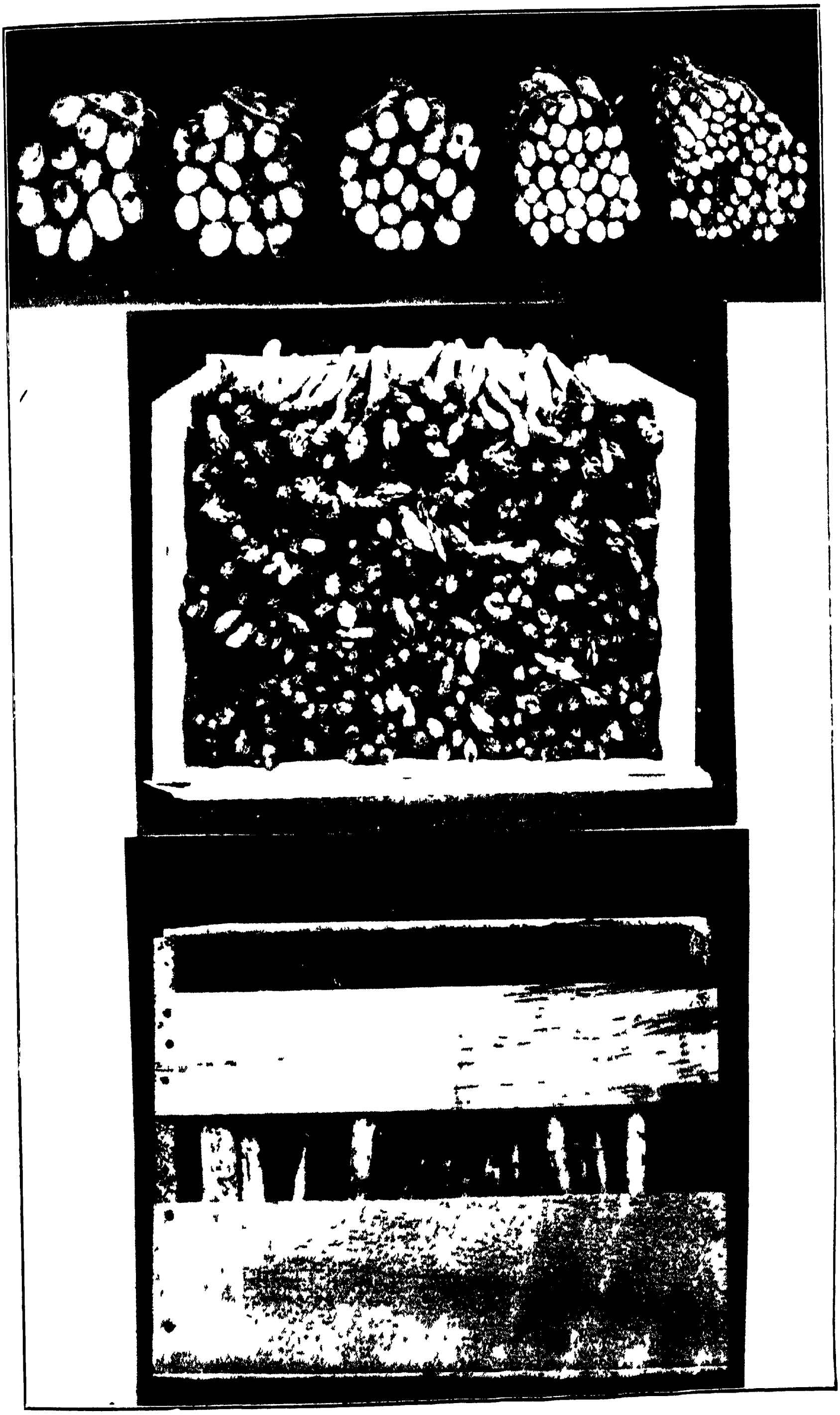

FIG. 1.—*Top* Graded Californian Asparagus
Centre Asparagus packed loose and ungraded
Bottom Type of Box for loose pack Asparagus

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FIG. 2.—*Top, left*: Asparagus Bunching Machine.
Top, right: Bunched Asparagus.
Centre: Asparagus in Waterproof Wrappers, on Damp Moss.
Bottom: Case of Asparagus ready for Market.

at the top, the tops of the boxes being made about 2 in. narrower than the bottoms in order to prevent the bunches from moving. The boxes are sometimes lined with paper to prevent drying, and a layer of wet sphagnum moss is usually placed on the bottom of the box to keep the cut surface of the butt ends moist.

Markets.—California depends on the eastern markets to absorb a certain proportion of its early asparagus crop, and it is not surprising that a great deal of importance is attached to grading and packing for New York, Boston, and Chicago. In fact, most areas which supply foreign or distant markets send their best attractively packed. It is as true of asparagus and peaches as it is of apples. There appears to be a fairly unanimous opinion amongst salesmen that English asparagus packed in smaller and better graded bunches would secure better returns to the growers. Whether or not the English markets will pay for home-grown asparagus better graded and packed can only be decided by experiment.

The writer is indebted to Dr. H A. Jones, of the Department of Agriculture, California University, who, during my recent visit to the Experimental Farm at Davis, California, very kindly gave me permission to use the photographs in this note.

THE CONTROL OF AMERICAN GOOSEBERRY MILDEW

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THE American gooseberry mildew has now been present in this country for a quarter of a century, but it cannot be said that the methods of control so far available have proved entirely satisfactory. There is a considerable lack of quantitative experimental evidence, obtained from thoroughly trustworthy spraying trials carried out on a fairly large scale, on which adequate recommendations for control can be based to meet all conditions. To remedy this state of affairs investigations on the control of this mildew have now been added to the programme of work adopted by the Long Ashton Research

Station, and it is believed that the results of the trials described below will be of considerable interest.

During the spring and summer of 1925 comparative trials of four washes for the control of this mildew were carried out by the writer, on a commercial scale, near Cheltenham. The degree of control obtained by three of the sprays employed was striking, and justifies the publication of the results; but it must be borne in mind that the experiment is to be regarded as a preliminary one, and further extensive trials must be carried out under varying weather conditions, and with several different varieties, before any one spray can be recommended as being the best to use.

The Experimental Plots.—The bushes used were of the variety "Winham's Industry," this variety being particularly susceptible to the mildew and fairly resistant to spray injury. They were average well-grown bushes, eight years old, and had been planted in four blocks twenty-five feet apart, two rows in each, the individual bushes being six by four feet apart. Standard plum trees were growing between the two rows of bushes in each block.

Each of the four blocks consisted of 48 bushes. The central eight bushes in each block (32 in all) were not sprayed, and these served as a control plot, which traversed the four blocks at right angles. The remaining 40 bushes in each block, 20 on each side of the control, constituted the four plots which were sprayed with the four washes.

Spray Fluids Employed.—The following four spray fluids were used, made up to the formulae given below:—

A. AMMONIUM POLYSULPHIDE AND SOFT SOAP

Ammonium polysulphide (1919 formula)	4 pints
Soft soap	5 lb.
Water, to make up to	100 gal.

B. PROPRIETARY SODA-SULPHUR COMPOUND AND SOFT SOAP

Soda-sulphur compound	10 pints
Soft soap	5 lb.
Water, to make up to	100 gal.

C. WASHING SODA AND SOFT SOAP

Washing soda	19 lb.
Soft soap	11 lb.
Water	100 gal.

D. BURGUNDY MIXTURE

Copper sulphate	15 lb.
Washing soda	34 lb.
Water	100 gal

Application of Spray Fluids.—The washes were applied by means of a hand-pumped "Rapid" spraying machine, working at a pressure of 60-80 lb., the nozzle used producing a medium-fine misty spray. Particular care was taken to spray the lower parts of the bushes and, as far as possible, the under-sides of the leaves. To ensure uniform treatment all spraying was done personally by the writer.

Time of Application.—The sprays (A), (B), and (C) were applied on April 28, immediately after the setting of the flowers, at which time no sign of the disease was visible on any part of the bushes. The second application of (A), (B), and (C) and the *first* application of (D) took place on June 5. At this time the mildew had appeared on the control plot and on plot (D).

Results.—The fruit from the various plots was picked on June 23-25, that from each plot being picked separately. It was sorted into two grades—clean and mildewed berries—which were then weighed. The fruit from the control plot was treated similarly. The following table gives the weight of clean and mildewed berries from each plot :—

Spray used	Clean fruit lb.	Mildewed Fruit lb.	Percentage Mildewed fruit by weight
A. Ammonium polysulphide and soft soap	90	4	4·2
B. Soda-sulphur compound and soft soap	132	3	2·2
C. Washing soda and soft soap ..	92	4·25	4·5
D. Burgundy mixture	94	27	22·3
Control. No spray	36	28	43·7

Remarks.—From the above table it will be seen that sprays (A), (B), and (C) all gave very good results, but it is not considered that the trial was on a sufficiently large scale to obtain figures so free from experimental error as to permit of an accurate determination of the *relative* efficacy of the three sprays. Further trials are necessary before definite conclusions can be arrived at. The time of the first application of the sprays, *i.e.* as soon as the flowers had set, is considered important. At this date (April 28) no sign of the disease could be seen, yet it would appear that small infection centres, originating from the winter spores, must have been present

though invisible to the naked eye, since the control bushes were heavily infected before the second application was made (June 5). In the case of plot (D), in which the first application was not made until after the mildew had become visible, only a comparatively poor control was obtained. It is essential therefore that fruit growers should not wait until the disease can be seen before commencing to spray.

It is obvious that spray (D), Burgundy mixture, was applied too late to check the disease effectively; it is possible that this would be an efficient spray if applied three or four weeks earlier. When applied after the berries are half-grown the latter are rendered unsaleable owing to the visible deposit on their surfaces.

The spray (C), washing soda and soft soap, was tested because this, if always efficient, would be a valuable and economical wash for use with certain varieties which are damaged by the sulphur-containing spray-fluids. Further, it is readily made up by small growers and private gardeners, the ingredients being common household commodities. Trials made with soda in Russia several years ago also gave promising results,* and it has previously been used in this country by Mr. Lansdell, late of the Worcestershire Horticultural Department who kindly supplied the formula. No spray-damage was observed on any of the plots, and the same holds good for the variety "Keepsake," which was sprayed with similar materials at another centre.

The plots were inspected again on October 7, when it was found that on the control plot and on plot (D) many of the tips were brown with the mildew, whereas on plots (A), (B), and (C) they still remained clean.

The writer is greatly indebted to Mr. Frank May of Cheltenham, on whose plantations the trial was carried out, for giving every facility and for supplying labour and machinery; and also to Mr. G. H. Hollingworth, Agricultural Organiser for Gloucestershire, for his valuable help in selecting a suitable plantation.

* *See* this JOURNAL Nov., 1914, p. 740; also de Jaczewski, *Rev. de Phytopathologie Appliquée*, I, 1913, p. 87, and Leberjew, *Zeits. f. Pflanzenkrankheiten*, XXV, 1915, p. 37 (abstract).

JUNE ON THE FARM

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Seasonal Notes.—With the passing of May the countryside begins to take on its summer colours, the pale green characteristic of spring foliage giving way to duller and darker hues. The apple and its kind have now set their fruit—such as was not destroyed by the May frosts—and the chestnut, the lime, and other timber trees have put forth their blossoms. In the fields the meadows now approach the time for cutting; corn comes into ear; root crops add a tinge of green to the hitherto bare fields; and beans, peas, and red clover, not to mention charlock, all come into flower.

On arable farms there may still be a considerable acreage of turnip crops to drill in June. North of the Trent swede sowing is generally completed in May, only the softer kinds being sown after that month. Hoeing and singling of root crops of all kinds are, however, important June operations. It has repeatedly been emphasised in this JOURNAL that early thinning has an important effect on yields, and even gapping or bunching the seedlings in advance of singling is visibly beneficial. Farmers lay stress on the need for uniform spacing of the roots at a certain distance; and it is obvious that the work of singling should be performed with as little injury or disturbance as possible to the seedlings selected to be left. Yet experiments have not shown that it materially affects the yield whether the roots are left 6 in. or 10 in. apart in the rows. Marrow stem kale is grown either unsingled or singled like root crops, according to the predilection of the grower, and it appears to thrive equally well under either treatment; but where it is to be cut and carted off for feeding to cows, there is an advantage at this time in having the plants spaced. This crop, it may be here mentioned, is particularly responsive to nitrates.

Livestock are believed to make their most rapid growth during this month. The grazing is at its maximum nutritive value, having become less watery but not yet too fibrous; the time has not arrived when growth fails to keep up with consumption, and the animals are not yet troubled by heat and pests. This may not apply to sheep, however, for at this time of the year flies begin to give trouble. June is the

recognised month for turning out calves, a practice which we commend on the ground that they thrive better in the following year.

Sheep Shearing.—In southern districts suckling ewes as well as eild sheep are usually clipped in May; in the Midlands June is the ordinary shearing month; mountain flocks, however, are not shorn until the latter end of June, and it is generally July before the ewes are clipped. The proper time for shearing is indicated by the rise of growth of the new coat, which does not appear until the animal has begun to respond to the improved conditions of temperature and food supply associated with the advance of spring. Dry stock are usually a week or two earlier in this respect than ewes with lamb; moreover, to avoid the risk of udder chills, this part of the flock is not shorn so early as the hoggs.

Subject to weather and wool considerations, early clipping is good practice. The ewes are relieved of the considerable weight of the fleece; they are more easily kept clean and free from ticks and fly, and an early growth of the new wool not only protects the sheep from the midsummer sun, but also ensures a better covering in winter. It is also advantageous to complete the sheep shearing before all hands are required for the root singling and hay harvest.

Formerly sheep shearing was an important rural festival, of which an illustration may be found in Shakespeare's play, "The Winter's Tale." The festival was one of great antiquity, as may be gathered from the incident recorded of David's call upon Nabel in Carmel, when the latter was shearing his three thousand sheep. It was at this season also that in more recent times Coke of Holkham and the Duke of Bedford at Woburn, pioneers of agricultural improvement in this country, entertained their numerous visitors. The Holkham gatherings (1778-1821) developed into world-famous meetings of farmers, the place of which was not filled until the agricultural show system grew up.

Washing.—Where the shearing machine is used, and especially with sheep that have wintered on root land, washing may be a necessary preparation. It is obvious, too, that washed fleeces have a more marketable appearance, and farmers who take pride in their products naturally prefer to sell their clip in good condition. The present tendency,

however, is to omit the washing. Washing is not without risk and it may entail some delay in clipping, because sheep cannot be washed without regard for temperature considerations; and unless time is allowed for the yolk to rise again after washing, both the weight and the condition of the wool suffer. In some districts farmers who have tried washing their sheep have received no more per pound for their wool than others obtained for unwashed clips. Wool experts, however, strongly advise adherence to the old custom of washing before shearing, and marketing the clip in the best possible condition.

Branding.—Marking is not done until a short time after clipping, but in view of the damage often done to the wool or the skin, it calls for special mention. When branding is done at clipping time or within a week after, or if the iron or pitch are too hot, the skin of the sheep may be wounded, and this also renders the pelt of considerably less value. If the marking is delayed, however, the tar or pitch may spoil too much wool. Flockmasters are still awaiting the discovery of a marking substance that is free from serious objections.

Dipping—At the time of writing, farmers do not know what will be the regulations for the next dipping; but in the event of double dipping being prescribed, it should be observed that an Order has been issued prohibiting the use of arsenical dips for the second immersion. As regards poisonous dips for the first dipping, too much care cannot be exercised to prevent accidents; last summer I traced two cases of proved arsenic poisoning in cattle to their having had access to sheep dip. Not all deaths of sheep after dipping, however, are due to the kind of dip used. Many experienced flockmasters emphasise the need for fasting the sheep and resting them in close quarters the night before dipping.

Haymaking.—When the weather is settled, considerable economy of labour and time can be effected by mowing a large area in advance, so that the requisite drying is performed by the sun and atmosphere with little artificial aid. Under such conditions a youth with one horse, a swath-turner and a side delivery rake, can prepare the work for a considerable staff of men engaged in leading and stacking. This method, however, occasions much loss when attempted in a bad season or when an initial spell of good weather is interrupted by a wet period. Perhaps there is now little excuse for a farmer to be caught with a large area of grass down, since weather

forecasts have attained such a high degree of reliability and are both published in the newspapers and broadcast three times a day.

The great drawback to meadow land is the difficulty of securing the hay in good condition in seasons when, as happens about twice in each decade, a spell of bad weather extends over most of the ordinary haymaking period. Many fields are then not mown at all, and little use can be made of the uncut first growth or of the "aftermath," unless the land is sound enough and otherwise suitable for out-wintering. The main losses, however, are in the waste of labour and of nutritive value of the hay that is cut and got. The valuation of bad hay in costing rations is consequently a great problem; it may have cost much more to produce than good hay, but be really worth only half as much.

In districts where normally the weather in June and July is fine for only short periods, farmers customarily follow the slower and more laborious methods necessary to secure good hay under such conditions. These include cocking, opening out, and recocking in the evening—or earlier if rain threatens. There are also special methods, details of which I have previously described in this JOURNAL (June, 1924). Ensilage is another possibility.

Curing-Trucks.—Most farmers have, no doubt, observed that when a load of insufficiently dried hay has been left on a vehicle under cover, it has considerably improved in condition by the time it has come to be unloaded. This principle has been extended into a method of haymaking practised in certain wet districts of America and recommended by the United States Department of Agriculture for wider adoption under similar conditions, and especially for lucerne hay. The special equipment used in this method is a canvas-covered curing-truck, which may be described as a skeleton hay wagon on low wheels. The bottom consists of seven rails, 12 ft. long, 4 in. by 2 in. in section, and placed about 14 in. apart on cross pieces; and the "raves" or "gormers" are triangular, being carried up to an apex for the purpose of supporting the ridge pole, over which the canvas is to hang.

In using the truck, the hay is first cured about to the stage when ordinarily it would be cocked. It is then loaded on to the curing-truck, without much tramping down; the sides of the load are carefully raked down to turn rain; the canvas

rail is put on and the canvas thrown over it and tied down. The load on the truck remains in the field from three to seven days, curing before it is stacked or baled. A load is from 13 cwt. to 18 cwt. of cured hay.

The obvious drawback to this method is the number of trucks required and their cost, but if, as the United States Department claims, this method "makes reasonably certain the production of good quality hay even during unfavourable weather," the curing-truck may soon repay its cost. The cost of the skeleton body without wheels would not be prohibitive, and it would not be difficult to economise on wheels by devising a separate carriage, which, with the help of jacks, could be run under the body for loading and taken away while the truck stood on legs in the field.

With the oak coming out before the ash, as is the case this year, farmers may perhaps expect to have no occasion to consider special methods and devices for haymaking in bad weather. At the moment of writing, however, growth is so backward, owing to the cold weather from mid-April to mid-May, that if the proverbial dry summer does come there may be very little grass at all to mow.

MONTHLY NOTES ON FEEDING STUFFS

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Rice Milling By-products.—Large quantities of rice by-products reach the English markets and differ considerably in composition. As harvested and cleaned for the miller rice consists of brownish or reddish grains enclosed in a hard grey flinty husk. The milling of rice, which results in the production of a clear translucent white grain, takes place in several stages. After cleaning the rough paddy rice from impurities, the rice is passed through two millstones which crack the husk and so sets free the brown grains within. During this process a material consisting of finely broken rice hulls and rice grains is separated, and is known as "*stone bran.*" By means of fans the main bulk of the hulls is removed from

the brown rice grains. The process is again repeated with such rice as has escaped husking in the first process, and finally the separation of grain from husk is completely effected. The aim of the miller is to complete this stage of the process without breaking the rice grains. The dehusked rice grain is now treated with a machine called the "huller," which removes most of the outside seed coat or bran of the rice. The "stone bran" already referred to is generally mixed with the bran produced by the hullers, and the combined product is known as "rice bran." The final stage in milling consists of removing the thin outer covering left by the hullers, and the by-product resulting from this process is known as "*rice polish.*" Paddy rice when milled gives rise to 18 per cent. of hulls, 8 per cent. of bran, and 2·5 per cent. of rice polish, so that considerable quantities of these products arise in the preparation of rice for human consumption.

Composition and Feeding Value.—The following figures, extracted from Bulletin No. 191, Texas Agricultural Experimental Station, gives the average composition of rice by-products :—

	Protein	Fat	Crude fibre	Soluble carbs.	Ash	Water
Stone bran ..	9 8	7·7	20·9	36·7	15·2	9·7
Rice hulls ..	3·6	0·9	39·1	29·4	18·6	8·5
Rice bran ..	13·6	14·8	11·7	40·1	10·0	9·8
Rice polish ..	12·9	9·1	2 1	61·8	4·2	9·9

The ash of rice by-products is largely insoluble, consisting chiefly of silica. Rice hulls are of little value for feeding purposes, being high in crude fibre and high in insoluble ash. Rice bran always contains a certain amount of hulls, owing partly to milling difficulties in separation, and partly due to the inclusion of "stone bran" in the rice bran. The crude fibre in rice bran should not, however, exceed 15 per cent. crude fibre, the presence of fibre in excess of this amount indicating either carelessness on the part of the miller, or deliberate adulteration with rice hulls. Both rice bran and rice polish are valuable feeding stuffs, and can be used successfully for all classes of stock. Owing to the high oil content, both rice bran and rice polish show a tendency to become rancid with long storage. It is also inadvisable to use these materials too lavishly in a ration, inclusion of 60 per cent. of rice polish in a ration for pigs having caused scouring. Experiments have also shown that inclusion of large quantities of rice bran and

rice polish in a ration for pigs gives rise to soft pork or bacon. In moderate quantity rice bran and polish are esteemed for feeding milch cows, but soft butter will result from lavish use of these materials. Owing to the tendency of these materials to become rancid, and the possibility of adulteration with rice hulls, purchasers should always exercise caution in buying from doubtful or unreliable sources, and should always insist upon preliminary inspection and a complete analysis.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows :—

	Starch equivalent	Protein equivalent	Per ton £	Per ton s.
Barley (imported)	71	6 2	8	14
Maize	81	6 8	8	1
Decorticated ground nut cake	73	41 0	11	10
„ cotton cake	71	34·0	9	15

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2·19 shillings, and per unit protein equivalent, 1·73 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1925, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9 6	8 14
Oats	60	7 6	7 4
Barley	71	6·2	8 6
Potatoes	18	0 6	2 0
Swedes	7	0 7	0 16
Mangolds	7	0·4	0 16
Beans	66	20	8 19
Good meadow hay	31	4·6	3 16
Good oat straw	17	0·9	1 19
Good clover hay	32	7·0	4 2
Vetch and oat silage	13	1·6	1 11
Barley straw	19	0·7	2 3
Wheat straw	11	0·1	1 4
Bean straw	19	1·7	2 4

DESCRIPTION	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British..	—	—	13 0	0 15	12 5	72	3 5	1·83	9·6
Barley, British feeding ..	—	—	9 5	0 12	8 13	71	2 5	1·29	6·2
„ Canadian No. 4 Western	32 3	400	9 0	0 12	8 8	71	2 4	1·25	6·2
„ American	30 6	„	8 10	0 12	7 18	71	2 3	1·20	6·2
„ Russian	31 0	„	8 13	0 12	8 1	71	2 3	1·20	6·2
Oats, English, white	—	—	9 17	0 13	9 4	60	3 1	1·65	7·6
„ „ black and grey	—	—	9 13	0 13	9 0	60	3 0	1·61	7·6
„ Scotch, white	—	—	10 7	0 13	9 14	60	3 3	1·74	7·6
„ Canadian No. 2 Western	31 9	320	11 2	0 13	10 9	60	3 6	1·87	7·6
„ „ No. 3 „ ..	29 3	„	10 5	0 13	9 12	60	3 2	1·70	7·6
„ „ feed	27 3	„	9 10	0 13	8 17	60	2 11	1·56	7·6
„ American	25 9	„	9 0	0 13	8 7	60	2 9	1·47	7·6
„ Argentine	25 6	„	8 18	0 13	8 5	60	2 9	1·47	7·6
Maize, Argentine	33 9	480	7 17	0 12	7 5	81	1 9	0·94	6·8
„ South African	35 6	„	8 5	0 12	7 13	81	1 11	1·03	6·8
Beans, English winter.. ..	—	—	11 0	1 11	9 9	66	2 10	1·52	20·0
Peas, „ dun	—	—	11 10	1 7	10 3	69	2 11	1·56	18 0
„ „ maple.. ..	—	—	11 13	1 7	10 6	69	3 0	1·61	18·0
Rye, home-grown	—	—	9 10	0 15	8 15	72	2 5	1·29	9·1
Millers' offals—									
Bran, British	—	—	6 2	1 6	4 16	42	2 3	1 20	10 0
„ broad	—	—	7 10	1 6	6 4	42	2 11	1·56	10·0
Middlings, fine, imported .	—	—	7 15	1 1	6 14	69	1 11	1·03	12·0
„ coarse, British ..	—	—	6 17	1 1	5 16	58	2 0	1·07	11·0
Pollards, imported .. .	—	—	5 17	1 6	4 11	60	1 6	0 80	11 0
Meal, barley	—	—	10 0	0 12	9 8	71	2 8	1·43	6 2
„ maize	—	—	8 15	0 12	8 3	81	2 0	1·07	6·8
„ „ South African .	—	—	8 0	0 12	7 8	81	1 10	0 98	6 8
„ „ germ	—	—	8 0	0 18	7 2	85	1 8	0·89	10·0
„ „ gluten feed ..	—	—	9 2	1 6	7 16	76	2 1	1 12	19·0
„ locust bean	—	—	9 5	0 9	8 16	71	2 6	1·34	3·6
„ bean	—	—	12 5	1 11	10 14	66	3 3	1·74	20 0
„ fish	—	—	18 0	4 1	13 19	53	5 3	2·81	48·0
Maize, cooked flaked	—	—	10 5	0 12	9 13	85	2 3	1·20	8·6
Linseed—									
„ cake, English, 12% oil	—	—	11 15	1 16	9 19	74	2 8	1 43	25·0
„ „ „ 10% „	—	—	11 7	1 16	9 11	74	2 7	1·38	25·0
„ „ „ 9% „	—	—	11 2	1 16	9 6	74	2 3	1·20	25 0
Soya bean „ 6% „	—	—	11 0	2 11	8 9	69	2 5	1·29	36·0
Cottonseed cake, English, 5½%„	—	—	6 5	1 13	4 12	42	2 2	1·16	17·0
„ „ Egyptian, 5½% „	—	—	5 17	1 13	4 4	42	2 0	1·07	17·0
Decorticated cottonseed cake, 7% oil	—	—	9 15	2 11	7 4	71	2 0	1·07	34·0
Decorticated cottonseed meal, 7% oil	—	—	10 10	2 11	7 19	74	2 2	1·16	35·0
Coconut cake, 6% „	—	—	8 15	1 10	7 5	79	1 10	0·98	16·0
Ground nut cake, 7% oil ..	—	—	8 5	1 15	6 10	57	2 3	1·20	27·0
Decorticated ground nut cake, 7% oil	—	—	11 10*	2 13	8 17	73	2 5	1·29	41·0
Palm kernel cake, 6% oil ..	—	—	6 15	1 2	5 13	75	1 6	0·80	17·0
„ „ „ meal, 6% oil	—	—	7 0	1 2	5 18	75	1 7	0·85	17·0
„ „ „ meal, 2% „	—	—	5 10	1 3	4 7	71	1 3	0 67	17·0
Feeding treacle..	—	—	6 12	0 9	6 3	51	2 5	1·29	2·7
Brewers' grains, Dried ale .	—	—	6 10	1 3	5 7	49	2 2	1·16	13·0
„ „ „ porter .	—	—	6 0	1 3	4 17	49	2 0	1·07	13·0
„ „ Wet ale ..	—	—	0 18	0 9	0 9	15	0 7	0·31	4·8
„ „ „ porter .	—	—	0 13	0 9	0 4	15	0 3	0·14	4·8
Malt culms	—	—	6 2	1 13	4 9	43	2 1	1·12	16·0

* At Hull

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store The prices were current at the end of April and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 8d.; P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o r in towns named, and are net cash for prompt delivery.

Description	Bristol	Hull	L'pool	London	Cost per unit at London
	Average price per ton during week ended May				
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	14 2	13 10	13 7	13 10	17 5
„ lime (N. 13%) ..	..	12 10	..	12 7‡	19 0
Sulphate of ammonia—					
Neutral (N. 21·1%)	13 1*	13 1*	13 1*	13 1*	(N)12 4
Kainit (Pot. 20%)	3 12	3 0	..	..	..
„ (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	..	..	3 9	3 3	3 2
Muriate of potash (Pot. 50-53¼%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51¼%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 34%)	..	..	3 9§	..	..
„ (T.P. 30%)	..	2 15§	3 0§	..	..
„ (T.P. 28%)	..	2 9§	..	..	..
„ (T.P. 26%)	..	2 3§	..	..	..
„ (T.P. 24%)	..	1 19§	2 3§	..	..
Ground rock phosphate (T.P.58%)	2 17¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 14	3 5	1 10
„ (S.P. 32%) ..	..	..	3 11	..	..
„ (S.P. 30%) ..	3 0	2 17	3 7	2 18	1 11
Bone meal (N. 3¾%, T.P. 45%) ..	8 15	8 5	8 10	7 15	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 2†	6 10†	5 15	5 10	..
Fish guano (N. 6¼%, T.P. 10%)..	..	..	..	7 17	..

Abbreviations: N.=Nitrogen; S P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in the home counties.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are f.o.r. at Northern London Stations Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f o r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton.

MISCELLANEOUS NOTES

Insect Pests

IT is perhaps now regarded as a truism that insect pests are the cause of very heavy loss of farm and garden crops, and a considerable amount of work is being done to determine satisfactory methods of reducing their depredations to a minimum. For many years past the Ministry has issued leaflets embodying the most recent information as to the best means of combating a number of pests, and it has now collated in book form twenty-seven leaflets dealing with some of the more important species attacking farm and garden crops. This little volume, covering 111 pages, contains well illustrated accounts of the following pests :—

The bean aphis.
Cabbage caterpillars.
The cabbage root fly.
The carrot fly.
The celery fly.
Chafer beetles.
Colorado beetle.
Daddy longlegs or crane flies.
Diamond-back moth.
Flea beetles.
The frit fly.
The gout fly.
Mangold fly.
Millepedes and centipedes.
Mustard beetles.
Narcissus flies.
The onion fly.
Pea and bean beetles.
Pea and bean thrips.
Pea and bean weevils.
Slugs and snails.
The stem eel-worm.
Surface caterpillars or cutworms.
Swift moths.
The turnip gall weevil.
The wheat bulb fly.
Wireworms.

The number of insect pests attacking farm and garden crops is large—so large that it has been possible to deal individually with but a comparatively small proportion of them in this collection of leaflets. On the other hand, the control measures which it is possible to take are few, and as the majority are illustrated by one or other leaflet, hints may be obtained not only as to how to deal with the particular pests described in the volume but with many others which do similar damage.

The volume, Sectional Volume 11 (*Collected Leaflets on Insect Pests of Farm and Garden Crops*), may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W. 1, price 1s. 3d., post free.

Export of Breeding Stock

NUMBER and declared value of animals living, for breeding exported from Great Britain and Northern Ireland in the three months ended March, 1926, compared with the corresponding period in 1925. (From returns supplied by H.M. Customs and Excise.)

Country to which exported	January to March, 1926		January to March, 1925	
	Number	Declared value	Number	Declared value
CATTLE		£		£
Argentina	136	23,130	137	34,667
Brazil	8	1,800	0	0
Canary Islands	23	475	0	0
Chile	30	2,670	0	0
Denmark	1	120	29	1,260
Uruguay	31	7,436	24	4,796
Australia	35	6,421	0	0
British India	6	350	10	355
Falkland Islands	10	361	0	0
Irish Free State	1,663	30,363	1,028	17,018
Kenya	5	300	16	966
Union of South Africa	7	350	20	1,850
Other countries	10	1,147	14	1,150
Total of cattle	1,965	74,923	1,278	62,062
SHEEP AND LAMBS				
Argentina	141	4,135	245	7,099
Peru	0	0	90	1,156
Switzerland	8	120	0	0
Uruguay	11	147	32	975
Irish Free State	121	310	79	248
Kenya	0	0	9	172
Union of South Africa	0	0	25	326
Other countries	9	484	5	78
Total of sheep and lambs	290	5,196	485	10,054
SWINE				
Argentina	2	65	6	115
Belgium	6	240	30	200
France	15	342	5	34
Germany	3	70	6	397
Peru	0	0	5	95
Russia	180	3,646	0	0
Serb-Croat-Slovene State	40	1,250	0	0
Irish Free State	155	810	119	533
Union of South Africa	0	0	4	90
Other countries	4	87	7	167
Total of swine	405	6,510	182	1,631

Government Assistance for Land Drainage

OUT of 27,000,000 acres under crops and grass in England and Wales, at least 1,200,000 acres are in areas which are waterlogged, and another 500,000 acres in areas which are capable of being improved by drainage operations. These latter areas include some of the richest land of the Kingdom, as they comprise a good deal of alluvial soil in the valleys and estuaries of the larger rivers. The loss to the nation in food alone, due to this land being undrained, has been estimated at £18,000,000 annually, in addition to the loss to the country through the smaller employment of labour.

If land is allowed to remain wet and cold, the germination of seed and the ripening of crops will be delayed; rushes, sedges, marestail and other weeds will abound; on wet pastures liverfluke, foot rot and other diseases will infest live-stock, and fungus and insect pests deal havoc among food plants. In fruit plantations, the danger from spring frosts will be intensified, and on wet lands the time for seasonal cultivation will be limited. This last factor is very important to gardeners and small growers whose land is waterlogged and cannot be worked early enough in the year to take advantage of early markets, or late enough to grow produce for sale in the autumn. There is also a serious waste of manures and fertilisers on badly-drained land.

For the past three or four years the Government has been able to assist land drainage authorities during the winter months, by making grants out of State funds, for the carrying out of drainage works and the alleviation of unemployment. A great deal has been effected by these means in the protection of land from inundation and in the improvement of drainage. The unemployment grants for this purpose, however, have now come to an end, and as stated in this JOURNAL for April last, the Ministry has obtained Government sanction to continue to assist this object, apart from the alleviation of unemployment, for another five years. The money at the Ministry's disposal will be confined to such drainage schemes as will confer a wide benefit on agricultural land. Drainage authorities which have been constituted by statute will be assisted to carry out approved schemes, and the Ministry is in a position to consider such schemes from authorities which come within the defined scheme. Each scheme will have to be explained fully and illustrated by

a 1 in. map showing the location of the proposed work, and no requests for assisting weed-cutting operations or works of maintenance which the drainage authority should normally carry out, will be considered. It is intended that as regards the most suitable labour to be employed for each scheme, ex-Service men in the district should be chosen if possible. The wages paid will be at the market rate for the district, and permission is to be given to pay a reasonable allowance for travelling to men living more than two miles from their work.

The Ministry hopes that drainage authorities will take the greatest possible advantage of the facilities afforded. Farmers who find that a combined scheme of drainage in their area is necessary before they can improve the soil, should co-operate and petition the Ministry to form a drainage authority under the powers which the present legislation provides, if there is not one already in existence. If there is a drainage authority, they can apply to it to proceed with their comprehensive schemes of work.

Beet Growing Experiments in Ulster

THE growing of sugar beet as a new Ulster industry is dealt with in the concluding Report of the Commission appointed to inquire into the Natural and Industrial Resources of Northern Ireland. The Commission report that experiments conducted in various parts of Ireland established the fact that sugar beet can be grown in Ireland with results equally satisfactory in point of yield and sugar content to those obtained in most of the recognised beet-growing countries on the Continent, but it is pointed out that the results of these tests should not be regarded as conclusive proof that the crop, if grown in the ordinary way, would assure equally satisfactory results. It is, however, stated that there appears to be ample reason to believe that, once the necessary experience is acquired, it could be grown as successfully as on the Continent or in England.

It is pointed out that the introduction of the industry into Northern Ireland could not increase the acreage under tillage, and it would simply mean substituting one root crop for another, and after full consideration of all the details—

costs based on the rates of the subsidy at present being granted by the Imperial Government, cost of factory, returns to the farmer—compared with the potato crop, the Commission has unanimously recommended to the Government that

> the question of providing a State subsidy to permit of the establishment of the industry should be postponed for a period of two years.
>
> It is further recommended that the Ministry of Agriculture, in order to test the suitability of soil and climate for the production of the crop on a commercial scale, should be authorised to arrange for the growing of a limited acreage of sugar beet in various districts, purchase the beet thus grown at the price paid by the factories in Great Britain, and dispose of it to either an English or Scottish factory.

In this way reliable data will be procured, and farmers will have an opportunity of forming their own judgment on the suitability of sugar beet as a substitute for other root crops.

Foot-and-Mouth Disease.—Since April 20, there have been seven outbreaks of Foot-and-Mouth Disease, five of which occurred in existing areas, namely, one in the Barnsley area, and four in the area round Hull.

The two new centres occurred on May 17, on which date disease was found at Waltham-on-the-Wolds, near Melton Mowbray, and at Ryde, Isle of Wight.

In all there have now been seventy-five outbreaks since January 1, 1926, involving fifteen counties, and the slaughter of 1,600 cattle, 8,374 sheep, 1,391 pigs, and 1 goat.

QUESTIONS IN PARLIAMENT

Pigs.—In reply to a question by Mr Foot Mitchell, M.P, asking what was the decline in the number of pigs in this country from the total of 1924 to that of 1925, and what were the reasons assigned by the Department for it, the Minister stated that the number of pigs on agricultural holdings in England and Wales as returned on June 4, 1925, was 2,644,356, as compared with 3,228,330 a year earlier, a reduction of 583,974. This reduction was attributed to the very low prices realised for fat pigs during 1924, as a result of the large numbers of pigs in that year, not only in this country but in Canada, Denmark, and the United States. The number of pigs in England and Wales in 1924 was by far the largest ever recorded, and the number in 1925 was appreciably above the average of previous years. (May 3, 1926.)

Division of Land (Games).—In reply to a question by Mr. Griffiths, M.P., asking whether figures could be given showing the amount of land that was diverted from agricultural uses in order to be devoted to golf or other games and to the provision of private parks, the Minister stated that no statistics were available at present of the area of land devoted

to such purposes, but some inquiries had recently been made on the subject, and it was hoped to publish the results of these inquiries in the Report on the Agricultural Census of production which will probably be issued before the end of the year. In reply to a supplementary question by Mr. Noel Buxton, M.P., who asked if an endeavour would be made to adapt the annual returns so as to get, if possible, full information in regard to this subject, the Minister said he would see how far that was practicable. (May 3, 1926.)

British Sugar (Subsidy) Act.—In reply to a question by Sir W. de Frece, M.P., asking for a statement as to the subsidy on each 7 cwt. of molasses produced as the result of refining a ton of beet sugar; the amount realised by the sale of such 7 cwt. of molasses in the open market; and the reason for State assistance in this connection, the Minister said: The question assumes that 7 cwt. of molasses are the result of refining a ton of beet sugar. This cannot be assumed, because the rate of extraction of sugar varies at each factory, and at two of the factories raw sugar is produced and not white sugar. In addition to variations in the weight of molasses per ton of sugar, there are variations in sweetening matter, to which different rates of subsidy and Excise Duty are applicable. On molasses of 70 per cent. and over of sweetening matter, the rate of subsidy is 12s. 4·7d. per cwt., and the rate of Excise Duty 4s. 8½d. per cwt.; on molasses of 50 to 70 per cent. sweetening matter, the rate of subsidy is 8s. 10·9d. and the Excise Duty 3s. 4⅛d. per cwt.; if not more than 50 per cent. sweetening matter and not less than 45 per cent., the rate of subsidy is 4s. 3·8d. per cwt. and the Excise Duty is 1s. 7½d. per cwt. Quotations for cane molasses are given in trade papers, but are no guide to the prices obtained by the beet sugar factories. These prices have not, so far as my information goes, been less than 1s. 6d. per cwt. in bond. Prior to the grant of a subsidy, the industry enjoyed remission of Excise Duty on sugar and sugar in molasses. Excise Duty has been reimposed in each case, and a definite rate of subsidy for a period of years substituted. (May 4, 1926.)

In reply to a question by Mr. Duckworth, M.P., whether, under the subsidy given for molasses, a further grant of 4s. 7·1d. over and above the 4s. 3·8d. per cwt. is given provided such molasses contain about 2 per cent. to 3 per cent. of extractable sugar, and that such sugar is wasted since the product is comparatively valueless; and whether he will consider the desirability of continuing such assistance, the Minister said:—I am aware of the differences in the rates of subsidy payable on molasses as set out in the First Schedule to the British Sugar (Subsidy) Act, 1925, but I would point out that the rates are related to the percentage of sweetening matter present, and not to the percentage of crystallised sugar which may be extractable from molasses by further independent process. I am assured that the factories endeavour to extract all possible sugar from the beet juice so as to leave as little sugar as possible in the residue in order to earn a greater amount of subsidy on sugar as sugar. With regard to the latter part of the question, I would refer the hon. member to my reply on May 4, to the hon. member for Blackpool (Sir W. de Frece). The cessation of State assistance upon any class of sugar product upon which subsidy is paid and excise duty imposed would reduce the total measure of assistance granted by Parliament to the industry as a whole and would be a breach of faith. I am therefore not prepared to consider any alteration in the molasses scale. (May 17, 1926.)

Liquid Manure.—In reply to a question by Mr. Riley, M.P., asking whether, having regard to the prevalent waste of liquid manure in this country, steps would be taken to disseminate information as to the methods employed in Germany and other countries for saving liquid manure, the Minister stated that the Ministry already published leaflets, which have a wide circulation, dealing with the use and conservation of liquid manure. (May 4, 1926.)

Land Settlement Schemes.—In reply to a question by Mr. Riley, M.P., asking what was the number of land settlement schemes now being administered by county councils in England and Wales ; if there were any such schemes still under the direct administration of the Ministry of Agriculture ; and, if so, how many, the Minister stated that the number of separate schemes of land settlement now being administered by county councils and the councils of county boroughs in England and Wales, including land acquired before, as well as since, the War, was as follows :

County councils	4,500
Councils of county boroughs	46

Seven schemes were directly administered by his Department, exclusive of two which are being transferred to the respective county councils as from Lady Day last. (May 4, 1926.)

Land Drainage.—In reply to a question by Mr. Riley, M.P., asking whether and when it was proposed to introduce legislation with regard to land drainage, as outlined in the White Paper on Agricultural Policy issued at the commencement of the present session, the Minister stated that the legislation with regard to land drainage, referred to in the White Paper on Agricultural Policy, was comprised in the Land Drainage Bill which had passed through all its stages in the House of Lords and was awaiting a Second Reading in the House of Commons.* (May 4, 1926.)

Beet Sugar Factories and Refineries (Employees).—In reply to a question by Sir J. Pennefather, M.P., asking whether any workers in the sugar beet factories were regarded as skilled ; and, if so, the number of such men employed permanently in the different sugar beet factories and in the refineries respectively of the country, the Minister, replying for the Minister of Labour, stated that the number of workers in recognised skilled trades employed permanently in the nine beet sugar factories operating last season was approximately 400. The number of skilled workers employed in British refineries was, he was informed, estimated at 1,934. The two figures were not strictly comparable, for in refineries a number of process workers were regarded as skilled, whereas in beet sugar factories such workers were generally regarded as non-skilled. As his hon. Friend was aware, five further beet sugar factories would be operating in the coming campaign. (May 20, 1926.)

Tuberculosis Order (Exchequer Contribution).—In reply to a question by Capt. D'Arcy Hall, M.P., asking whether representations had been

* The Land Drainage Bill passed Second Reading in the House of Commons on May 7, 1926, and was committed to a Standing Committee.

received by the Minister from local authorities expressing the view that his Department should make the same contribution towards the cost of administration of the Tuberculosis Order of 1925 as it now made in respect of compensation for slaughtering animals; and whether, since legislation was needed for the purpose, he would bring before the Government the urgent need for taking steps to submit such a Measure to the House, the Minister stated that the answer to the first part was in the affirmative. The Exchequer contribution already amounted to rather more than 50 per cent. of the total cost of carrying out the Tuberculosis Order, and he could not, therefore, hold out any hope of fresh legislation to enable the Exchequer grant to be increased. (May 20, 1926.)

NOTICES OF BOOKS

East Malling Research Station, East Malling, Kent. Annual Report for 1924.—The calls made by horticulturists on this research station increased more rapidly than could have been foreseen, with the result that the station has now to record a shortage of land, insufficient funds and inadequate building accommodation. In spite of all these handicaps, however, the report shows that very material progress has been made in adding fresh knowledge on many of the obscure problems of plant growth. The station is largely concerned with investigations in the field, and the nature of the material prevents any rapid unfolding of Nature's secrets, but on the contrary leads to a gradual unfolding of processes which, pieced together, permit deductions to be made. In relation to many problems the results have warranted certain deductions, and the present report contains an excellent series of papers giving fresh knowledge on certain aspects of fruit growing and practices for pest control.

Generally, the problems have been well defined, the trials carefully and clearly explained, and the full results given, so that readers may acquire the proper interest in the work and follow the deductions with ease. The work is so interestingly dealt with that readers may become absorbed in these field trials and the lessons they teach.

The paper dealing with field observations on the incidence of leaf scorch upon the apple shows that apple stocks may do more than influence growth of varieties, their blossoming and cropping, for types of stock such as IX, I and XVI may induce in the variety an apparent immunity to leaf scorch, as contrasted with Type V (the improved Doucin), which increases the variety's susceptibility to this defect.

That Type IX can induce varieties to blossom earlier in the season than similar varieties on Type XIII is substantiated by two excellent photographs—a contrast sufficiently striking to convert the greatest antagonist of this doctrine.

The well-known results of the black currant trials have been submitted to a critical test, with the result that the average crop figures for three years place the five varieties tested in the following order:—Baldwin, first; Goliath and Boskoop (equal), second; and Seabrooks and French (equal), third. These Malling trials have given a new lease of life to the Baldwin, and make it the most popular variety of the day.

Mr. N. H. Grubb has contributed a paper on raspberry varieties and their cropping, in which growers can find just the information that many are wanting, *e.g.*, "The combination of qualities necessary to make a raspberry suitable for marketing in punnets is found, in our conditions, in only three or four varieties. Of these the best by far are Lloyd George and Pyne's Royal. Lloyd George is the better coloured and the better flavoured of these, its fault being that it is only barely firm enough for the purpose; and some people object to its shape as being too like that of a loganberry. The fruit of Pyne's Royal is firmer, &c."

The report contains several papers concerning pests and diseases of fruit trees to which readers are referred. Space here will permit the mention of two, the control of the apple-blossom weevil, and of the big bud mite of black currant. These have been troubles of long standing with the grower, and the new methods of control should prove a boon to many.

Poultry run under the apple trees proved useful in controlling leaf-eating weevils, but, with one exception, the hens, though only fed sparingly, showed a dislike for the apple-blossom weevils, and certainly offered no effective means of control. Very few beetles were caught in the ordinary grease band. Old sacking bands tied around the trunks of the trees attracted the beetles, which entered them in large numbers during the months of July, August, September and October, to pass the period of rest. The beetles can be removed with the bands at the end of the year, and destroyed. The method is a simple, practical and a very effective one for reducing the pest, and one that growers will wish to try.

The big bud mite has been a terrible nuisance in black currant plantations, and hand-picking of the big buds was the best that one could advise in the past. The East Malling investigators, in the light of their field experiments, now confidently recommend that the mites can be killed by spraying the black currant bushes with winter strength lime-sulphur wash (1.025 sp. g.) just as the bloom trusses are appearing but before they open. Slight scorching will almost certainly result, but the bushes suffer no ultimate damage.

Papers on the testing of new varieties of hops, and on corn and potato trials, are included, also an excellent report on trials of runner beans, in which the characteristics of the more important varieties have been recorded. The inclusion of these papers shows that the programme of work at the Research Station is broadening out to help the many varied farming interests in Kent.

The investigations, penned so admirably in this report, deal with everyday troubles as they occur up and down the country in the commercial plantations, and growers will find the stories of these field investigations very absorbing reading, apart altogether from the knowledge to be gathered. When the reader finishes the last page and places the book away on his bookshelf for reference, he is left with the impression of a very live Station staffed with an industrious team of scientific, yet very practical, workers, and of the immense assistance that this Station is giving to the fruit-growing industry.

H. V. T.

The Law of Allotments and Allotment Gardens (England and Wales). By E. L. Mitchell. Re-issue of Third Edition, 1922, with Memorandum on the Allotments Act, 1925. (London: P. S. King & Son, Ltd. Price 7s. 6d. net).

The law relating to allotments is complicated and somewhat difficult to follow owing to it being contained in four different enact-

ments, and for this reason the present handbook, which explains concisely the various statutory provisions on the subject within the covers of a single volume, should prove of considerable assistance both to the Local Authorities responsible for the administration of the Allotments Acts, and to Allotments organisations.

The Act of 1922 contained provisions restricting the power of landlords to terminate the tenancies of land which had been let for cultivation as "allotment gardens." These provisions do not apply, however, in the case of allotments which are not "allotment gardens," and, in addition, the tenants of the two types of allotments are entitled to compensation on different bases on the determination of their tenancies. These matters, which are slightly involved, are clearly explained in Chapters V and VI of the work.

The above Act also laid down new principles in regard to the financial aspect of Councils' allotments undertakings, and as to the basis on which the rents of allotments are to be fixed. The experience of the Ministry tends to show that considerable misapprehension exists on these matters, both among local authorities and allotment holders, and accordingly the chapter dealing with finance will well repay a study by all interested in the administration of the Acts.

The section relating to the acquisition of land should also prove of interest, setting out, as it does, in detail the various steps which are necessary in connection with the exercise of compulsory powers.

The text of the various Acts, so far as they relate to allotments, and of the Rules, Regulations, &c, which have been drawn up by the Ministry, are printed in an appendix.

The main body of the work deals with the position as it was after the passing of the Act of 1922. The Allotments Act, 1925, however, in addition to introducing certain new features, made a few minor modifications in the pre-existing law, and it is therefore desirable that the various chapters should be read with the memorandum which has been inserted at the end of the volume, explaining the provisions of the last-mentioned Act.

SELECTED CONTENTS OF PERIODICALS

Agriculture, General and Miscellaneous

Eradication of Bracken, *J. H. Milne Home* (Scottish Jour Agr., IX., 2 (April, 1926), pp 129-136.) [63.259]

Experiments on Making Hay with Heated Air, *J. Hendrick.* (Scottish Jour. Agr., IX, 2 (April, 1926), pp. 136-146) [63.1902]

Live Stock

The Production of Baby Beef in Northern Ireland, *G. S. Robertson.* (Scottish Jour. Agr., IX, 1 (January, 1926), pp. 4-9.) [63.62.]

Recent Research in Pig Feeding, *J. Golding.* (Welsh Jour. Agr., II (1926), pp. 159-163.) [63.64 : 043.]

The Influence of Ultra-Violet Light on Nutrition, *J. M. Henderson.* (Scottish Jour. Agr., IX, 1 (January, 1926), pp. 33-39.) [612.394.]

The Effect of Minerals in Overcoming Breeding Difficulties in Certain Sows, *R. G. Baskett.* (Agr. Prog. III (1926), pp. 34-36.) [63.64 : 043 ; 612.]

Pig Selection Methods in Denmark, *P. A. Morkeberg.* (Pig Breeders' Annual, 1926, pp. 48-56.) [63.64.]

Pig Improvement. Commercial Requirements, *H. R. Davidson.* (Scottish Jour. Agr. IX, 2 (April, 1926), pp. 146-156.) [63.64.]

Dairying

Some Results and Further Points in the Feeding of Dairy Cows, *R. Boutflour.* (Scottish Jour. Agr., IX, 1 (January, 1926), pp. 70-75.) [63.711 : 043.]

Judging Dairy Cattle and Some of its Problems, *J. W. Gowan.* (Jour. Heredity, XVII, 1 (January, 1926), pp. 13-26.) [63.711 (064).]

The Rationing of Dairy Cows for Milk Production, *J. Mackintosh.* (Jour. Farmers' Club, March, 1926, pp. 17-38.) [63.711 : 043.]

Silage *versus* Swedes for Milk Production, *A. C. McCandlish* and *A. McVicar.* (Scottish Jour. Agri., IX, 2 (April 1926), pp. 194-201.) [63.711 : 043.]

Casein and the Dairy Industry, *R. A. Berry.* (Scottish Jour. Agr., IX, 2 (April, 1926), pp. 167-171.) [63.715]

Veterinary Science

Grass Disease in Horses, *S. H. Gaiger.* (Essex County Farmers' Union Yearbook, 1926, pp. 290-301.) [619.1]

Liver Rot.—I Former theories on the cause of Liver Rot in Sheep, *D. H. Robinson.*
II Eradication of Liver Rot, *J. Ritchie.*
(Scottish Jour. Agr., IX, 2 (April, 1926), pp. 189-193.) [619.3.]

Bovine Tuberculosis in Relation to the Health of Man, *J. Penberthy.* (Jour. Bath & W. & S. Counties Soc., XX (1925-26), pp. 86-94.) [614.54.]

Economics

The Economic Lag of Agriculture, *C. Dampier Whetham* (Econ. Jour., XXXV, No. 140 (Dec., 1925), pp. 536-557.) [338.1.]

The Importance of the Farmer's Contribution to Food Supply in 1918, *Sir Thomas Middleton.* (Essex County Farmers' Union Yearbook, 1926, pp. 185-196.) [338.9.]

The Land and the Nation, *C. Dampier Whetham.* (Econ. Jour., XXXVI, No. 141 (March, 1926), pp. 11-28.) [333.5.]

The Profit Cycle in Agriculture: Some Notes on Factors which affect its Intensity, *H. Belshaw.* (Econ Jour, XXXVI, No. 141 (March, 1926), pp. 29-49.) [338.1]

Land Settlement in Canada, *H. P. Desjardins.* (Int. Rev. Agr. Econ. IV, 1 (Jan.-Mar. 1926), pp. 3-49.) [325 (71).]

Conservation and Formation of Small Holdings in Denmark. (Int. Rev. Agr. Econ., IV, 1 (Jan.-Mar., 1926), pp 50-69.) [333.38 (489).]

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NOTES FOR THE MONTH

The Marketing of Empire Fruit

THE Imperial Economic Committee, appointed to consider possible improvements in the Marketing and Preparing for Market of Foodstuffs produced in the Overseas parts of the Empire, have now issued their Third Report, dealing with fruit. The question of Empire fruit supplies has necessitated a much more exhaustive investigation than was required for the Committee's previous report on Empire meat supplies, in regard to which considerable data were already available from various inquiries that have taken place in recent years concerning the meat trade of the United Kingdom. No recent investigation had taken place on the subject of Empire fruit, and it was found necessary, therefore, to break fresh ground, and to take extensive evidence in order to place this particular investigation on the level attained in the case of other foodstuffs which have been officially investigated. The many kinds and varieties of fruit reaching this country from Empire sources involved a separate survey of each principal group known to Commerce, these separate reports, nine in number, dealing with apples, citrus fruit, soft fruit, dried vine fruits, dried tree fruits, bottled and canned fruit, fruit pulp, jam and crystallised fruit, nuts and bananas. With these separate surveys before them, the Committee have considered the problem as a whole and embodied, in a main report, their general conclusions, some of which will be of special interest to horticulturists in this country.

The supply of fruit to the United Kingdom is a trade of great magnitude, the value of the fruit imported in 1924 being

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* Command Paper 2658. Published by H.M. Stationery Office. Price 4s. 6d. net.

returned at £48,300,000. In the last twenty years the value of the imports of fruit has increased at nearly three times the rate of the imports of breadstuffs, and at nearly twice the rate of the imports of meat. Despite this, the consumption of fruit per head in the United Kingdom is still much smaller than in the United States.

Of the total fruit imports, however, more than three-quarters are derived from foreign countries and less than one-quarter from the Overseas Empire. There is great scope for increasing the importation from the Empire, firstly by an increase in consumption, and secondly by a transference to the Empire of the custom now given to foreign countries. It is the deliberate opinion of the Committee that the bulk of the fruit now derived from foreign countries, with the exception of grapes and oranges for winter consumption, might, at no very distant date, be obtained from British sources.

The result of such an expansion in the United Kingdom market for Empire fruit would result in a corresponding growth in Overseas Empire markets for manufactured goods, on account of the development of important districts in various parts of the Empire which are suitable for fruit production. In this connection, the Committee point out that, in 1925, the foreign countries from which our principal fruit supplies are derived only bought goods from us to the value of from 7s. to 19s. per head of their populations, as compared with the £2 10s. 0d. to £17 per head of population purchased by Empire countries who export fruit to the United Kingdom.

After careful investigation into the distribution of imported fresh fruit within the United Kingdom, the Committee has come to the conclusion that, under the present system or lack of system, the cost of distributing is, on an average, about equal to the whole cost of growing, carrying and handling up to, and inclusive of, the primary sale in the United Kingdom. This fact is of great importance not only to the British consumer but also to the Overseas producer. As raising domestic issues here, however, the Committee indicate that it is a matter rather for the Food Council than themselves.

On the question of defending and developing the Empire fruit industry, the Committee considered three policies. Schemes of embargo and licence are debarred by commercial treaty obligations of the United Kingdom; and Customs preference is excluded from the purview of the Committee by

agreement at the Imperial Conference of 1923. In these circumstances, the one policy that appears to the Committee as immediately available is that of developing voluntary preference on the part of the consumer. For the furtherance of such a policy it will be necessary to organise the producers within the Empire and also to mobilise the consumers within the United Kingdom. The Committee attach great importance to the adequate representation over here of the producers' organisations in various parts of the Empire, not only to watch the producers' interests but to keep them informed of market requirements. From the consumer's standpoint, the Committee consider that he should be provided with such indications of origin as will assist him to exercise his voluntary preference. A scheme of educative publicity is also indicated to lead the consumer to see that it is in his own business interest, apart from all sentiment, to buy from his own best customers.

The policy of voluntary preference is not one upon which the Committee consider simple clear-cut recommendations would suffice to give it reality, and they ask that what might be described provisionally as an "Executive Commission" should be set up for the purpose of implementing schemes under their policy. They contemplate that this Executive Commission will include the interests of the home producer within its functions, in so far as those functions may be applicable to his case.

Feeding Value of Grazings

A VERY interesting and important research on the feeding value of growing grass when closely grazed is reported in the April *Journal of Agricultural Science*. The results will repay farmers' attention. Hitherto, no figures have been available of the composition and feeding value of growing grass, as grazed by animals. Information has been confined to grown grass approaching the hay stage. The Research Institute at Cambridge accordingly made arrangements to analyse first, and feed to sheep after, the produce of a pasture kept continuously short by mowing. At the same time, the produce of adjoining plots let go for hay was also periodically analysed. The first outstanding fact revealed was that the pasture was throughout astonishingly rich in

protein, more than twice as rich as grass at hay-making: and this richness remained remarkably constant throughout the whole grazing season from April to October. The growing grass was also highly digestible, more so than the best meadow hay, palm kernel cake, barley meal and undecorticated cotton cake, and equal to linseed cake itself. The nutritive value of short, fresh, green grass is therefore seen to be very much higher than it has hitherto been considered, and that it shows no decline as the season advances. Another point proved is that there is a considerable falling off in digestibility and nutritive value of young herbage allowed to continue growing till hay-making time, thus indicating that when pastures are allowed to become rough they lose appreciably in feeding value.

Closely cut pasture grass may be regarded as possesssing the character of a concentrate. It possesses indeed one feature which is lacking in a concentrate: it supplies all the animal's requirements for vitamines, and where the grass mixture is satisfactory, for example, mixed grass and clover, it supplies the animal's requirements for mineral matter also. It may therefore be asserted that the farmer's cheapest and possibly his best concentrated food is to be found growing within reach of his own homestead.

It is necessary to emphasise the fact that these conclusions are only true where pastures are kept short by being grazed to the fullest capacity. Pastures must not, of course, be overstocked, but they should be stocked sufficiently to deal with the continuous supply of short, succulent herbage. Where pastures have to be understocked it should not be impossible to mow off the excess of unconsumed herbage. This would lead also to an improvement in the character of the grazing, as it would discourage weeds and encourage clover and the finer grasses. It was specially noted in the course of the investigation how the repeated cuttings brought on the growth and spread of clover. The plots had all the appearance of having been heavily slagged.

A word of caution is necessary; the herbage from such a pasture as was studied in the Cambridge investigation must give an unbalanced feed for many classes of stock. That is to say, it requires to be accompanied by food of other sorts to make a proper ration. Even for animals with a large requirement for digestible protein, young growing stock and milking animals for example, a pasture of this kind may lead

them to consume an excessive amount of protein with a consequent harmful effect on the kidneys and general health. It would seem to be indicated that starchy rather than proteid concentrates are best adapted for feeding to animals on short, young grass.

Importation of Raw Cherries Order, 1926

THE Minister stated in the House of Commons on June 3 that officers of his Department were examining samples taken from consignments of imported cherries, and that in the event of the discovery of any serious infestation with the cherry fruit fly (a pest which has not established itself in this country) he proposed to issue an Order prohibiting the entry of cherries from the country in question, excepting such consignments as could be furnished with an official certificate that the fruit was grown in a district where the cherry fruit fly is not known to exist.

The examination of samples of French cherries on June 10 revealed the presence of some heavily infested consignments, and the Minister, in order to prevent the establishment of the pest in English cherry orchards, made an Order, which took effect on June 16, prohibiting the entry of any cherries shipped from a French port unless accompanied by an official certificate that the fruit was grown in a Department where the cherry fruit fly is not known to exist. Cherries not grown in France but shipped from a French port must be accompanied by a certificate of origin.

Coloured Wall Diagrams of Plant Pests and Diseases

To meet the need for good and technically correct diagrams of pests and diseases which attack agricultural and horticultural crops, the Ministry has produced the first four of a series of coloured wall diagrams. The subjects illustrated are :—(1) Apple Blossom Weevil ; (2) Winter Moths ; (3) Apple and Pear Scab, and (4) Silver Leaf. The diagrams measure 30 in. by 20 in. and are beautifully executed by the four-colour process. They are scientifically exact, attractive, clear and artistic. A reduced reproduction in black and white of the fourth of these is given herewith.

Of their kind, the diagrams now produced are unique, and should prove highly valuable to agricultural, horticultural and allotment societies; to Local Education Authorities for use in rural schools; to museums, colleges and public schools; to farmers and fruit growers; and to private individuals. The price of each diagram is 3s. unmounted, 5s. mounted and on rollers (post free). A descriptive leaflet is issued free with each diagram.

The Agricultural Index Number

Except in the case of potatoes and to a lesser extent in the case of fat cattle there were no marked fluctuations in the prices of agricultural produce as a result of the general strike in May. Several descriptions were, however, dearer on the average than in April, but owing to sharp reductions in the price of milk delivered to London and Birmingham, the general level of prices of agricultural produce was 1 point lower on the month at 52 per cent. above pre-war level, as compared with 56 and 57 per cent. in the corresponding months of 1924 and 1925 respectively.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921:—

Month	Percentage Increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	183	75	68	61	70	58
February	167	79	63	61	67	53
March	150	77	59	57	65	50
April	149	70	54	53	58	53
May	119	71	54	56	57	52
June	112	68	51	58	55	—
July	112	72	53	52	51	—
August	131	67	54	59	56	—
September	116	57	56	60	57	—
October	86	59	51	63	53	—
November	79	62	53	64	53	—
December	76	59	56	63	53	—

Grain.—Wheat and oats advanced in price throughout the greater part of May, and the former averaged 1s. 4d. and the latter 9d. per cwt. more than in the previous month, while barley was 3d. per cwt. dearer. The index figure for wheat rose

FIG 1 —Reduced reproduction in black and white of Diagram No 4.

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10 points to 67 per cent. above the price in May, 1911-13, while an increase of 4 points was recorded for both barley and oats, these two commodities being relatively cheap at 22 and 30 per cent. respectively above pre-war value. Wheat was 8d. per cwt. dearer than in the corresponding month of last year, but barley was 1s. 1d. and oats 5d. per cwt. cheaper.

Live Stock.—Owing to transport difficulties caused by the general strike, smaller supplies of fat stock were on offer in the early part of May, and both cattle and pigs sold at higher figures, but since then values became easier and prices for both these classes of stock at the close of the month were at practically the same level as at the end of April. Fat cattle were about 2s. per live cwt. dearer on the month and the index figure rose 4 points, while fat pigs realised 3d. per 14 lb. stone more, and as a slight decrease occurred in the base years the index number advanced 6 points. Fat sheep averaged ¼d. per lb. less than in April, but as this reduction was relatively not so sharp as that recorded in the basic period, the index number shows an advance of 8 points. Dairy cattle were nearly 10s. per head cheaper than in the previous month, and store cattle and sheep sold at slightly lower rates, but store pigs were rather dearer. As compared with May, 1925, both fat and store cattle and sheep were cheaper, but pigs sold at considerably higher figures.

Dairy and Poultry Produce.—The average price of milk delivered to London and Birmingham districts under the terms of the contracts made under the National Farmers' Union scheme fell from 1s. 4d. in April to 1s. per gallon in May, while average rates in the Manchester district were ½d. per gallon lower on the month. Milk was unchanged in price as between April and May in 1911-13, and as a result of the reductions recorded above the index figure fell 35 points to 60 per cent. above 1911-13 prices. Eggs, on the average, were unchanged, and as prices usually advance in May the index number was reduced 10 points. A reduction of 1½ per lb. was recorded for butter, but as this decrease was not in proportion to that recorded in May, 1911-13, the percentage increase over pre-war level rose from 49 to 52. Cheese sold at the same price as in April and was 83 per cent. dearer than in the base years. Eggs and butter made slightly lower prices than in the corresponding month of 1925, but cheese was nearly 10s. per cwt. dearer.

Other Commodities.—During the strike period potatoes at the wholesale markets advanced sharply in price owing to the extra cost incurred in road transport, but prices declined when normal methods of marketing were resumed, average rates being only 6s. per ton higher than in April. Potatoes only averaged 15 per cent. more than in the basic years and were nearly 50 per cent. cheaper than a year earlier. Both cauliflowers and carrots became dearer but cabbage was more plentiful and cheaper, the latter selling at rather more than double the pre-war price. Hay made slightly higher rates, but at only 9 per cent. above 1911-13 figures was still relatively the cheapest of all agricultural produce.

Index numbers of different commodities during recent months and in May, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	May	May	Feb.	Mar.	April	May
Wheat	38	59	60	55	57	67
Barley	46	36	19	14	18	22
Oats	30	36	27	25	26	30
Fat cattle	51	49	47	43	39	43
Fat sheep	87	100	50	52	59	67
Bacon pigs	29	60	89	85	82	88
Pork pigs	33	60	89	89	84	90
Dairy cows	58	48	40	37	39	36
Store cattle	42	40	37	31	31	29
Store sheep	96	99	53	61	60	55
Store pigs	36	55	121	115	119	122
Eggs	40	48	72	41	48	38
Poultry	87	55	50	50	46	61
Milk	50	55	74	72	95	60
Butter	40	54	47	46	49	52
Cheese	77	70	78	77	77	83
Potatoes	219	124	49	31	7	15
Hay	4	3	4	6	5	9

PRACTICAL SOIL STERILISATION BY HEAT FOR GLASSHOUSE CROPS

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SOIL sterilisation* is no longer looked upon by growers of glasshouse produce as an expensive luxury, but is regarded rather as a form of insurance and part of the year's work. The experiments of Sir John Russell and his colleagues in this country demonstrated the benefits to be derived from soil sterilisation, and served to stimulate some of the more progressive amongst the glasshouse growers to carry out their own experiments from a practical standpoint. The efficiency of steaming has never been questioned, but in the early days it was so expensive that only the largest growers would undertake it. In consequence, attention was directed to the alternative and cheaper process of sterilisation by chemical agents, of which pale straw-coloured cresylic acid (" carbolic acid ") immediately suggested itself. From the time this compound was first used commercially until the present day, chemical investigation has not failed to suggest new compounds, whenever interest seemed on the wane. Cresylic acid and other compounds have been and still are used on commercial nurseries all over the country, but save in isolated cases, they have failed to give results equal to those produced by heat. The explanation of this is probably concerned with the extreme difficulty, if not impossibility, of making intimate contact between the sterilising agent and every particle of soil. Maybe the chemist will produce the ideal chemical soil steriliser in the future, but until that day arrives one may expect to see rapid developments along the line which gives the best results, namely sterilisation by heat, effected either by steaming or by baking.

Baking.—As large quantities of soil cannot be baked economically, this method is not so popular as steaming, and is employed mainly for sterilising relatively small quantities of soil for propagating purposes.

While many devices have been improvised for baking soil, probably the most popular is one which consists of a metal box with a centre flue. This is built into a brickwork structure, so

* The word " sterilisation " is used in the present article not in its strict micro-biological sense, but as equivalent to " partial sterilisation."

that the heat from a fire placed beneath the box passes up the centre flue and round the outside of the box. In erecting the oven, as it is commonly called, care should be taken to construct the brick flues, so that the draught is just sufficient to do the work. If the draught is too strong the base plate of the metal box is soon burnt out. Soil is thrown into the box, and heated for twelve hours over a slow fire. No part of the soil is more than twelve inches from a heating surface and the bulk is more or less uniformly heated to 212° F. It seems likely that twelve hours' heating is excessive and that six hours or even less is sufficient. Experiments are now being carried out to determine the minimum time necessary to destroy organisms which cause disease. It is well, however, to be on the safe side, and slightly longer heating than necessary is better than too little. Our experience suggests that it is desirable to have a factory thermometer fitted through the side of the oven, with the bulb at the centre of the soil mass. By this means the temperature can be ascertained readily, and after it reaches between 205° F. and 210° F. another 60 to 120 minutes are sufficient to destroy any contamination that may exist.

For satisfactory baking, the soil must be in suitable condition. A porous soil bakes better and in a shorter time than a heavy clay soil, because, with the latter the heat must penetrate to the centre of the lumps if all the parasitic organisms are to be destroyed. Also, a relatively dry soil bakes better than a wet soil.

The question of moisture is important, for if the soil is too dry, complete sterilisation is effected and it becomes infertile. Cases of over-baking a dry soil have been observed, and plants grown in such soil made no growth until virgin soil was mixed with it. It will readily be seen that for complete satisfaction, soil for baking must be in good condition and reasonably moist. A baking oven to hold one ton of soil can be erected for approximately £40, and is a good investment for any grower who does not possess steaming apparatus.

The question of storing sterilised soil, prior to use, is important. For this purpose the provision of a suitable shed with a concrete floor cannot be too strongly recommended. Baked soil should be stored for six weeks before use, otherwise retardation of growth may occur. If this time cannot be allowed, the soil should be soaked with water before use, as this will prevent retardation to some extent.

Another method of baking soil, which, however, is not so reliable, is that of heating it in a shallow tray placed on top of an ordinary heating boiler. Usually the tray, constructed of galvanised iron, 8 feet long, 3 feet wide and 1 foot deep, is made to fit over the top tubes of an ordinary horticultural tubular boiler. Suitable brickwork is arranged to keep the heavy weight of the tray off the tubes, which might cause leakage at the ring joints of the castings. The tray is filled with damp soil to a depth of 12 inches, and covered with wood and waterproof sheeting. The soil is heated for 24 hours and after a time a temperature of 180° F. is reached throughout the mass. If the soil is too dry the heat will be imperfectly distributed, and the bottom layer of soil will be overheated. This must be prevented by damping the soil if necessary, before sterilisation.

Steaming.—Sterilisation by steaming is becoming increasingly popular because it has proved to be a money-making process. It is effected by passing into the soil large quantities of steam until the temperature becomes sufficiently high at the desired depth. For this purpose a steam boiler is required. A portable loco-type should be obtained, and a suitable one may be anything between 12 and 25 h.p. New boilers are usually insured to work from 160 lb. pressure upwards, but for practical purposes the actual working pressure will approximate to 70 lb. per sq. inch. The cost of a new boiler varies from £250 to £450. Having purchased a suitable boiler the grower is compelled to select, from the many methods in use, one which will suit his own particular requirements, and it may be useful, therefore, to discuss a few of the most popular devices.

Probably the three most popular methods are those known as the "Small grid," the "Tray," and the "Spike" respectively.

(*a*) *The "Small Grid" Method.*—This is probably the best of all methods of steam sterilising when the trouble is deep seated, for by its means the soil can be heated effectively to any reasonable depth. One of the leading exponents of this method is Mr. J. Harnett of Hoddesdon, and in his hands it has proved remarkably successful.

The apparatus (Fig. 1), made of 1 inch iron tube, is worked into the shape of a comb, the back of which varies in length between 8 and 10 ft. so as to fit the spaces between the hot water pipes. The length of the "teeth" varies from 2 ft. when the comb is 10 ft. long to 2½ ft. when the comb is 8 ft. long. The teeth are inserted at intervals of 10 to 12 inches along the "back" of the grid. Steam is liberated from holes a quarter

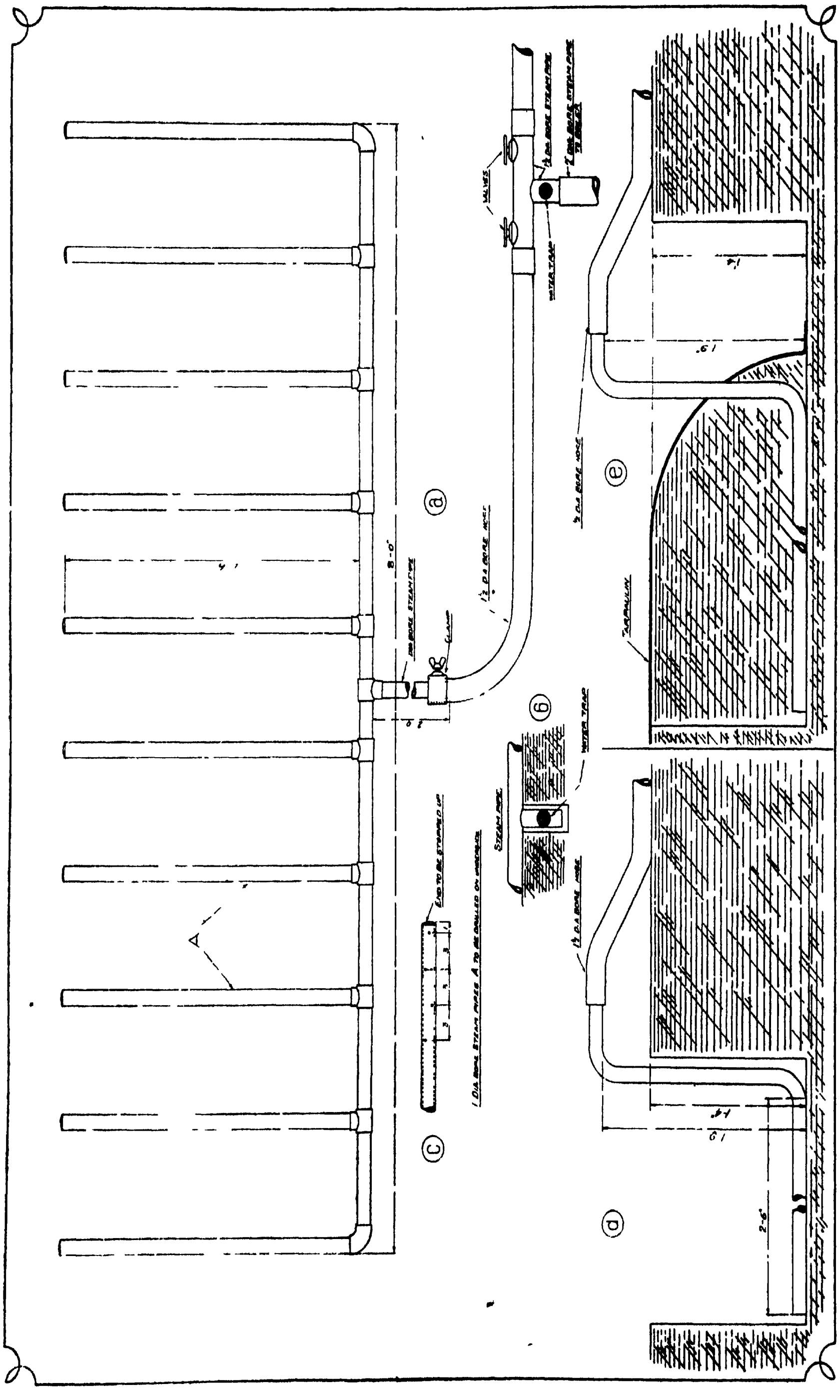

FIG. 1.—Steam sterilisation by the "small grid" method: (*a*) the apparatus, (*b*) water trap, (*c*) portion of grid showing position of the holes, (*d*) section showing the method of placing the grid in a trench, (*e*) section showing the soil in position during steaming.

of an inch in diameter, made on the lower side of the "teeth." The holes are placed alternately on either side at intervals of three inches. The ends of the "teeth" are sealed by means of a screw cap, and the last hole must be made exactly in the underside of the pipe to allow any condensed water to run out. A connection of 1 in. iron piping fitted into the "back" of the grid on the side opposite the "teeth," and bent like the handle of a plasterer's trowel, serves to connect the grid to a length of 1½ in. flexible hose piping which joins the main 2 in. (or 1½ in.) steam barrel leading to the boiler.

To use this apparatus, a trench is made 30 in. wide, 16 to 18 in. deep and long enough to take the grid. The soil from this first trench is removed to the place where the successive trenches will terminate and is used to fill in the final trench. The bottom of the trench is then pricked up and the grid placed on it. A second trench is taken out immediately behind, and the soil from it is thrown into the first trench, the grid being thus covered. When sufficient soil has been shifted, a tarpaulin or sail cloth is thrown over the top. It is convenient to have the covering material in strips which are rolled up at the end of the house and unrolled gradually to cover the soil. In this way the heated soil remains covered for several hours after steaming.

Steam is then passed for 15 to 20 minutes, after which time the soil should have become uniformly heated to a temperature of 210° F. to 212° F. By means of hooks, the grids are then pulled back into the second trench, which is filled up with soil from a third trench and steamed as before. This procedure is repeated until the whole area to be treated has been covered It is an advantage to work the grids in pairs, so that one is being prepared while the other is in use.

Success with this method depends to a considerable extent on keeping the pipes and grid free from condensation water. More trouble is caused by condensed steam in the pipes than by anything else. The holes in the "teeth," being located on the under surface, prevent the condensation water from filling the pipes, and the last hole, which is placed on the bottom of the tube, allows the water to drain away. In spite of this, the grids need careful attention, for any lodging of water in the pipes will cause failure by checking the flow of steam. A steam trap should be inserted in the system at the end of the steam barrel, just in front of the T piece connected to the hoses. If a steam trap is not available, a valve slightly opened can be fitted. This allows the condensation water to drain away

without appreciably affecting the steam pressure. The steam pipe leading from the boiler to the grids must be thoroughly insulated. A good plan is to surround the pipe with a 1½ in. layer of wood wool. This should be tied on and covered with thick brown paper kept in position with string. The brown paper rarely gets warm.

Mr. Harnett has kindly supplied the following details relative to the cost of this method :—

COST OF STEAMING ONE ACRE OF LAND, TWO FEET DEEP.

	£	s.	d.
Labour : 3 men and stoker for 32 days, including cost of fitting pipes	70	0	0
Fuel : 40 tons at an average of £2 per ton	80	0	0
Boiler	32	0	0
	£182	0	0

Against this figure must be set :—

(1) The cost of digging the soil, which, apart altogether from steaming, must be carried out each year, and is included in the above steaming costs, and

(2) The saving in fertilisers.

	£	s.	d.
(1) 3 men dig an acre in 20 days	30	0	0
(2) No stable manure is required after steaming, therefore, at least 30 tons at 15s. per ton is saved	22	10	0

A saving on the " base " fertilisers also occurs, but the amount varies considerably. It will be seen that a sum of £52 10s. 0d. at least must be subtracted from the steaming cost of £182 per acre, and this leaves the nett cost at approximately £130 per acre.

(*b*) *The " Tray " Method.*—This system is an old favourite which has served the nurseryman well. It was widely exploited by the late Mr. W. B. Randall, who did so much to make soil sterilisation popular in the Lea Valley. In this case, the steam is introduced beneath shallow inverted trays placed on the soil surface, and from them diffuses gradually into the soil. Care must be taken in the preparation of the soil prior to steaming, for upon this the penetration of the steam depends. It must be dug at least one spit deep and must be moderately dry. If the soil is too wet, the steam condenses before it has penetrated very far into it. Further, wet soil cakes together and prevents uniform diffusion of steam through the entire mass. The water present in the clay increases the specific heat of the soil, so that more heat is required to raise the soil to the desired temperature and imperfect sterilisation is the result. This method is not suitable for very heavy soils, which should be

steamed by either the "grid" system already described or by the "spike" method dealt with in a subsequent paragraph.

As the trays have to be lifted about the house, they must combine lightness with strength and efficiency. They are usually made of match-boarding and are lined with zinc to make them airtight. A more expensive and better tray can be made of galvanised sheet iron reinforced with "T" irons and "angle" irons. They are usually 9 in. deep, and of various sizes suited to the construction of the houses to be steamed. Unless the size of the trays has been well planned previously, hot water pipes, purlins, stays, etc., seem to get in the way on every conceivable occasion, and sometimes make steaming most unpleasant. The trays are placed on the soil and the steam is fed through suitable pipes introduced at one side (Figs. 2 and 3). These pipes are used "T" shaped, and thus connect two trays to the boiler at once. They are laid in shallow trenches under the tray, with the end of the pipe at the centre of the tray. A brick placed some 4 inches away from the end of the pipe serves to divert the steam as it emerges.

The number of trays which can be treated with steam at one time depends upon their size and the amount of available steam. Trays 8 ft. by 4 ft. may be steamed in pairs. When the pipes and trays are in position, the latter are pressed down into the ground, well packed with soil round the edges, and covered with tarpaulins. Steam is then passed and the temperature of the soil rises in accordance with the pressure on the boiler. Observations taken when using trays (9 ft. by 2½ ft. by 5 in.) in pairs, showed a temperature of 200° F. 10 in. below the surface 20 min. after passing steam at a boiler pressure of 115 lb., 30 min. at 90 lb. and 50 min. at 60 lb. These figures refer to one type of soil only. It has been found, however, that steaming at high pressures does not lead to uniform heating of the soil. If the thermometer is moved in the soil, the temperature will be found to vary from inch to inch. In actual practice it is best to steam at about 70 lb. pressure in the boiler. A wetter, heavier soil would require longer heating, and a drier, lighter soil less heating. The thermometer must be the guide in every case, and it is convenient to have one in a metal case, with a flange 10 in. from the end. By inserting the thermometer in the soil until the flange rests on the surface, the temperature at a depth of 10 in. can be recorded.

When it has reached 200° F., another 30 min. steaming should be given in normal soils. In very heavy soils, especially if disease has been troublesome, and time will permit, a longer

steaming may be given. Over-steaming has only once been recorded by the writer, and that under special conditions when shallow carnation beds were being treated.

It is convenient to have at least six trays, so that two may be prepared while two are in use, and two remain covering the steamed soil.

The cost of steaming by this method depends upon the purpose of the sterilisation. If the object is the elimination of disease by very thorough sterilisation, the following figures will apply :—

COST OF STEAMING 1·17 ACRES.

	£	s.	d.
Labour (20 days)	66	0	0
Fuel (39 tons, coke)	62	0	0
Boiler	64	0	0
Sundries	22	0	0
	£214	0	0

This is equivalent to £182 per acre. The saving on labour and manures approximates to £38 per acre, and thus reduces the nett cost of steaming one acre to £144. During the steaming period to which the above figures refer, three separate tests, each of 24 hours duration, were made. It was found that during 24 hours, 3,400 gal. of water were converted into steam, using 3,200 lb. of fuel, and 2,160 sq. ft. of soil were steamed to a depth of 12 to 15 inches.

It should be stated, however, that one grower, who applies this method to soil which has been regularly steamed every three years, and in which no real trouble exists, performs the operation at considerably less cost. His object is to sterilise the top 8 inches only, and so keep the soil in good condition. He also grows alternate crops of tomatoes and cucumbers instead of growing tomatoes continuously. The following cost figures were very kindly supplied by him :—

COST OF STEAMING ONE HOUSE, 200 FT. BY 30 FT., IN 1924.

					£	s.	d.
Labour : 3 men, each 36 hours, at 1s. per hour.. ..					5	8	0
Boiler : 36 hours at £1 for 24 hours					1	10	0
Coke : Supply for 36 hours—							
1 ton 4 cwt. 1 qr. at 31s. 8d. per ton	£1	18	5				
1 ton 2 cwt. at 23s. 0d. per ton	£1	5	3				
					3	3	8
Depreciation on hose and trays					1	8	4
					£11	10	0

£11 10s. 0d. for a house 200 ft. by 30 ft. is equivalent to £83 10s. 0d. per acre.

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FIG. 2 Tray Method of Steaming, showing Trays and Pipes ready to place in position.

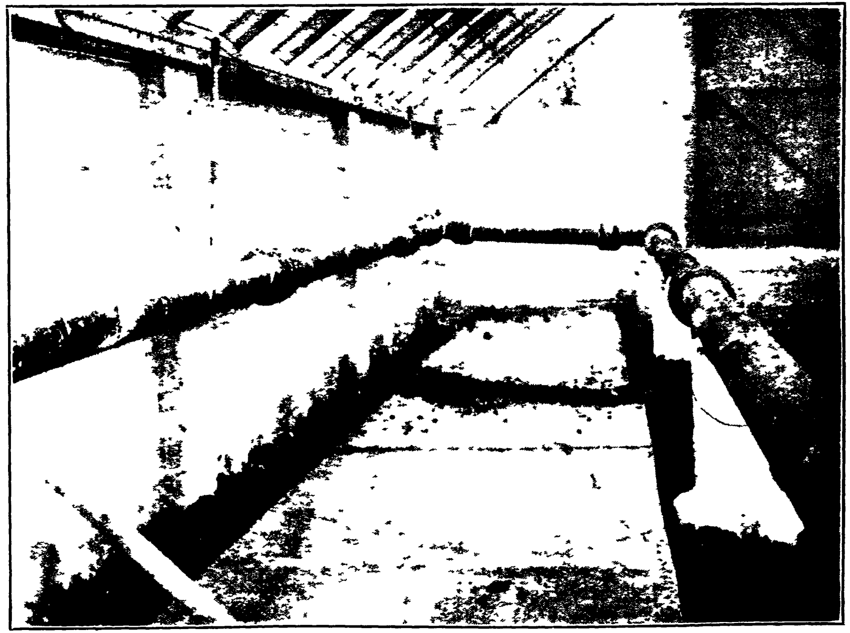

FIG. 3.—Trays in position ready to commence Steaming

Reproduced by kind permission of Messrs Ernest Benn, Ltd , from " Diseases of Glasshouse Plants "]

(e) *The "Spike" Method.*—This method has been in use for some 7 or 8 years. It is simple and entails little manual labour during the operation. The apparatus required is shown in Fig. 3. It is constructed of hollow iron piping of $\frac{3}{4}$ in. bore. The back of the apparatus is usually 8 ft. long. It has a short branch on one side for connection to the flexible hose, and six short branches, 16 in. apart, on the other. To each of these branches is fitted a 3 ft. length of 1 in. hose. The other ends of these short pieces of hose are fixed each to a steaming spike. The spikes are 2 ft. long, and the details of construction are shown in Fig. 4.

A handle (*a*) fixed at the top enables the spike to be moved easily, and short pieces of rubber hose may be slipped over the ends to supply a suitable grip. A metal stop is placed at (*b*) to keep the handle cool by preventing the steam from passing into it. The handle is also open at each end for the same purpose. Small holes $\frac{1}{8}$ in. in diameter are made at the end of the spike. The holes are arranged in three circles, six holes per circle, the circles being 2 in. apart. Steam enters through the side arm (*c*) and is emitted through the holes at the end of the spike. After lightly forking over the soil the spikes are taken to one end of the first house, and pushed into the ground to a depth of 18 in. in a line 16 to 18 in. from the wall, the spikes being 16 in. apart. Strips of sail cloth or other waterproof material are laid on the ground and tucked in round the spikes to retain the steam in the soil beneath. Sometimes a spike may be pushed into an uneven part of the soil, causing the steam to puff vigorously upwards along the line of the spike. This may be stopped by using a fork in the soil, some 18 in. away from the spike, and easing the soil upwards. Two sets of six spikes will span a strip of ground 16 ft. wide. One man can easily work these and attend to the boiler at the same time.

After the steam has passed for 8 minutes, it is cut off, and the spikes are lifted out to a position 16 in. further back, $2\frac{1}{2}$ minutes being occupied by the process. A house 160 ft. by 16 ft. can be steamed by this method in 30 hours. The spike system is slightly cheaper than the grid system.

Other devices, which necessitate the use of spikes, are used. One resembles a harrow. It is made of iron piping, and has numerous hollow perforated spikes which are pressed into the soil. Another apparatus consists of a small galvanised iron tray some 6 ft. long, 2 ft. wide, and 4 in. deep, holding a pipe

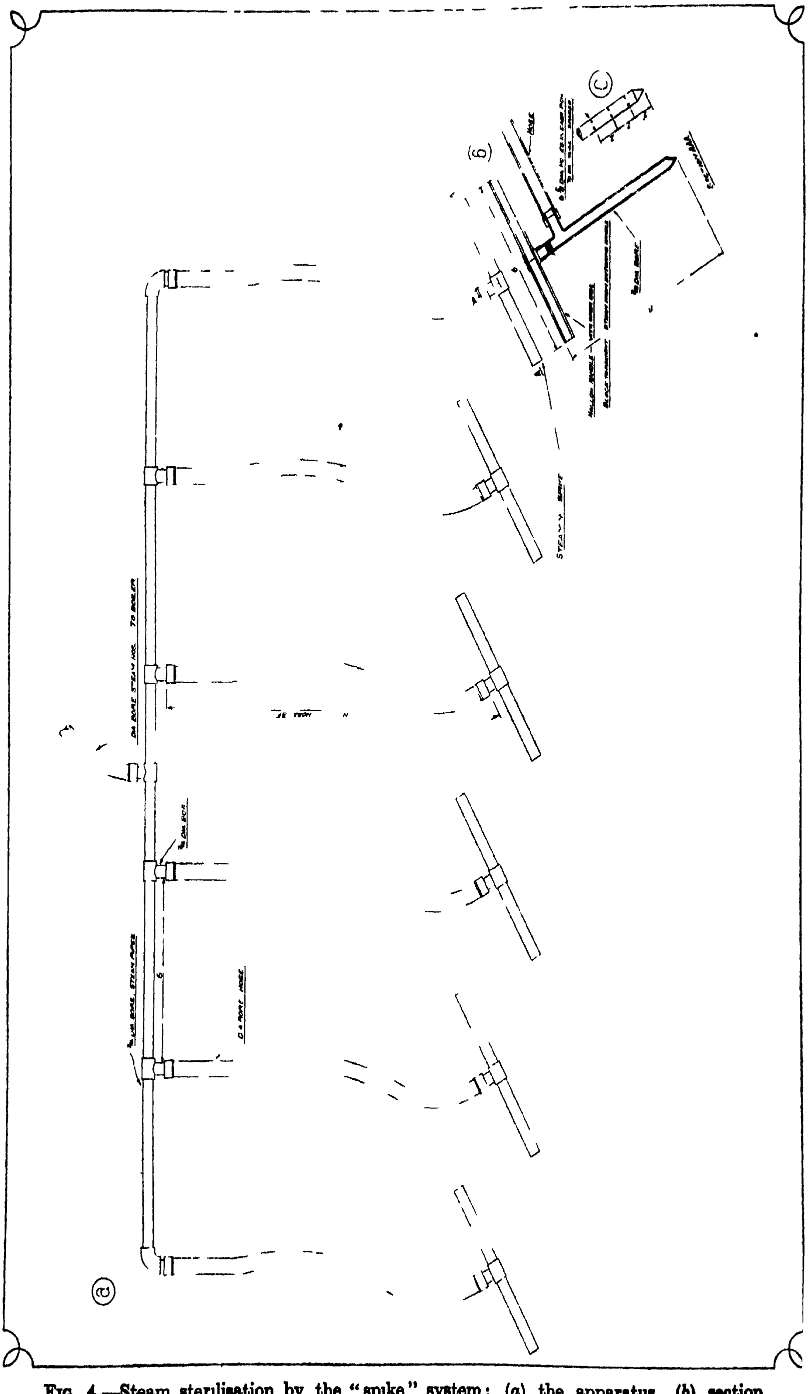

FIG. 4.—Steam sterilisation by the "spike" system: (a) the apparatus, (b) section through a spike, (c) external view of the end of a spike showing position of the holes.

which runs along the longitudinal axis of the under side, and from which hollow perforated spikes protrude into the soil. This should be an excellent device, but is apparently troublesome to handle.

The Purpose of Sterilisation.—Sterilisation of the soil may be undertaken for two main reasons, namely the presence of disease and loss of fertility. When disease has been serious, sterilisation must be very carefully performed. All infection must be destroyed, otherwise reinfection will rapidly occur and the soil will be as bad as ever in a year's time. When the disease organisms are only to be found near the surface, the tray system will suffice to destroy them, but it is ineffective in the case of those organisms that can penetrate to a depth of two feet or more, such as the eelworm which attacks tomatoes and cucumbers. Deep-seated troubles require drastic treatment, and the steam must be introduced in the region of the trouble. The small grid system is eminently suitable in such cases. The spike system should also prove valuable in the hands of careful manipulators.

In the case of loss of fertility, caused through no particular disease, the method of steaming depends upon the degree of "sickness." Generally speaking it pays to sterilise deeply and thoroughly the first time of steaming. This will last for four years, after which steaming must be repeated if the crop is to be maintained at a satisfactory level. If the soil possesses good physical characters and contamination is prevented, the later steaming need not be so thorough as the first, but, of course, the grower must be guided by the crop and the appearance of the roots at the season's end. It is, however, a simple matter to demonstrate the value of deep sterilisation, for tomato plants on such soil will maintain their vigour until November and even later, while those on soil steamed to a depth of 8 or 10 in. would be finished long before. All steaming should be completed by the second week in January, because it is an advantage to flood the soil heavily after steaming. Sufficient time must be allowed for the soil to become reasonably dry by the usual planting time.

Manurial Treatment after Steaming.—As shown by Russell and Petherbridge,* the steaming of soil leads to the accumulation of nitrogenous " food " without the liberation of additional

* E. J. Russell and F. R. Petherbridge, *Jour. of Agric. Science,* 1912, Vol. V, pp. 86 and 248.

supplies of potash and phosphate to counteract it. Consequently, plants in steamed soil, especially rich soil, tend to develop soft tissues, and must not be given nitrogenous fertilisers during the early part of the first season, unless the resulting crop shows a definite need for them. When tomatoes are grown in steamed soil, the usual treatment is ½ to 1 ton sulphate of potash per acre, applied fourteen days before planting. No other base manure seems to be necessary in the case of normal tomato soils, although some growers prefer to apply a mixture of potash and phosphate. The plants must be watched carefully until the first two trusses of fruit have set. Over-watering should be avoided, and the night temperature should be maintained about 60° F. Any tendency to bolt must be checked by the application of sulphate of potash (5 cwt. per acre is usually sufficient), and attention to details of temperature and ventilation. Some growers reduce the temperature of the pipes when they notice a soft growth. This is fatal. The temperature should be maintained uniformly, and the day temperature should be reduced by ventilation. A light overhead damping is advisable, as this helps the fruit to set.

On the other hand, poor soils do not benefit from sterilisation as much as moderately rich soils unless they are afterwards manured with stable manure and base fertilisers. The following figures taken from two nurseries are instructive :—

Nursery	Kind of soil	Yield of Tomatoes in tons per acre		
		Unsteamed	Steamed and treated with potash	Steamed and treated with stable manure and "base" fertiliser
No. 1 ..	Rich ..	34·4	46·5	41·4
No. 2 ..	Poor ..	29·7	37·6	45·8

It will be seen that steaming increased the yield in both cases and that the increase was greater in the case of the richer soil. The addition of stable manure after steaming depressed the yield from the rich soil, and increased it considerably on the poor soil. Thus in steaming, as in other horticultural practices, no hard and fast rules can be laid down; the grower must be guided by his own experiments. The wise grower will assume that steaming will enrich his land and cause a tendency to soft growth. He will arrange his cultural operations to counteract this, but he will keep in mind the possibility that in his case additional manures might be

beneficial, and will arrange an experiment to test this. A small trial is better than no trial, and should always be arranged.

Chemical Agents versus Steam.—No article of this kind can be complete without reference to the relative effects of steam and chemical sterilisation, because advisers are continually faced with the statement that growers cannot afford to steam. Our experience tells us that in reality growers cannot afford *not* to steam. Steam boilers can now be hired from certain firms, so that the initial heavy expense of purchasing a boiler need not be considered, although most growers with large areas to steam prefer to have their own boiler. Those who cannot hire a boiler can frequently purchase a small one at a relatively low figure, and while small boilers, working at low pressures, extend the time of steaming, this is no serious objection to a grower with a small acreage to sterilise.

Mr. J. Harnett has conducted careful experiments for the purpose of comparing the two methods of sterilisation, and his results have been published in the reports of the Cheshunt Experimental Station as follows :—

A block of houses, the soil of which had not been sterilised previously and in which tomatoes had been cultivated during twelve years, was set apart for this experiment. The soil of fifteen houses was steamed by the grid method to a depth of eighteen inches ; four houses were treated with 97 to 99 per cent. cresylic acid at the rate of 1 gallon over 9 sq. yards ; two houses were treated with certain liquid sterilising agents at the rate of 1 gallon over 22 sq. yards ; whilst two were left as controls.

It has long been realised that the difficulty of obtaining direct contact between chemical sterilisers and the finest particles of soil seriously affects their efficiency. Therefore in these experiments the application of such compounds to the soil was very carefully carried out. The method may be explained by reference to the application of cresylic acid. One gallon of the acid (pale straw-coloured, 97 to 99 per cent. purity) was placed in a tub containing about 40 gallons of water. An injector worked by water pressure was placed in the tub and the acid was gradually sucked out and watered on to the soil. Under the conditions of the experiment, approximately 89 gallons of water had passed through the injector by the time the tub was empty. Thus the acid was applied to the soil at a dilution of 1 in 129. The soil to be treated was

thoroughly broken up and then watered with the diluted acid. The tub was emptied over 18 sq. yards, and in the process the ground was covered twice. One man applied the acid while others followed behind and dug it into the soil. By this means the soil was treated and dug over twice. After an interval of eight or more days, to allow the soil to dry and become workable, the top spit of soil was turned upside down and a second application of acid, similar to the first, was made. It was considered that this method of application provided a better admixture of the acid with the soil than would usually occur in general practice.

The effect of these treatments upon the tomato crop is shown in the following table :—

Treatment	Yield in tons per acre	Relative yield
Steam	50·25	180
Cresylic acid	43	154
Other liquid sterilisers	33	114
Control	28	100

Such results should leave no doubt concerning the advantage of steam over chemical agents. Steaming need not be carried out every year; usually once in four years is sufficient. Cresylic acid and other chemical agents must be applied each year. Thus, in round figures, steaming costs about £200 per acre per four years, while cresylic acid costs £45 8s. 0d. per year exclusive of the labour necessary to apply it.

Points to remember:—

(1) Always be guided by a good thermometer.

(2) Sterilise as carefully and as thoroughly as you can.

(3) When fighting the eelworm, aim at heating the soil as far down as you can. This pest is frequently found beyond a depth of 18 in.

(4) Carelessness, as in everything, means waste of money.

(5) Never step from unsterilised soil to sterilised soil, or place unsterilised soil in contact with sterilised soil. You will reinfect it.

(6) Preparation of the soil beforehand is essential to success. Dry, open soils steam better than wet soils.

(7) Sterilisation enriches the soil by increasing the amount of nitrogenous foods. In rich soils the resulting crop tends to develop a soft growth, therefore withhold nitrogenous fertilisers and apply sulphate of potash and possibly some phosphate. Poor soils, however, react to nitrogenous fertilisers after steaming.

(8) Soil can be rendered infertile by overbaking, especially if it is too dry.
(9) Baked soil should be stored for six weeks before use.
(10) Sterilised soil in storage should be protected from reinfection.
(11) When disease appears after sterilisation, the process may not always be at fault. Contaminated water can cause reinfection.
(12) Consult an expert before undertaking sterilisation for the first time, and if possible inspect the different methods under working conditions.

WORK OF THE ORDNANCE SURVEY

Summary of a Paper read by Colonel-Commandant E. M. Jack, C.M.G., D.S.O., Director General of the Ordnance Survey, before Section E (Geographical) of the British Association Meeting of* 1925.

THE Ordnance Survey is the national survey of Great Britain, and is responsible for the survey and mapping of the whole country. It is unique of its kind, there being no country in the world possessing a national survey of anything like the completeness of ours.

A complete survey of a country must provide that country with a complete series of all those kinds of maps which it needs for its ordinary daily work and purposes. Such maps fall into the two broad classes called cadastral and topographical. A cadastral map shows property boundaries but not necessarily ground forms; a topographical map gives a correct representation of all topographical features, including ground forms. Great Britain and Ireland have a complete series of cadastral and topographical maps.

The difference may be appreciated by contrast with some other countries. France has a fair series of topographical maps and she has also a cadastral map, made about 100 years ago, never published and never brought up to date. It exists in manuscript, in innumerable small sheets and pieces, kept in various archives. If you want a large scale map of a property in France, you must go and copy one of these old plans, and then bring it up to date. Belgium is completely covered with an excellent topographical map, but has no cadastral map.

* Ordnance Survey Professional Papers, New Series, No. 10. H.M. Stationery Office, price 9d. net.

Germany, Austria and other countries are in the same condition. Some civilised countries have not even a complete topographical map. The United States are slowly mapping their huge territory, but are still a long way off having a complete topographical map and still further from a complete cadastral map; and the same with Canada.

Contrast this with Great Britain. We have not only a complete series of topographical maps, but the whole country is covered with a complete cadastral map on a uniform series, published and available to the public at a small cost, and systematically kept up to date. Another important point is that the whole of these maps, cadastral and topographical, large scale and small scale, have the same basis, namely the 25-inch map, from which all other Ordnance Survey maps have been produced by successive reductions and redrawing.

The 25-inch Map.—The 1/2500, commonly called the 25-inch map, the scale being 25 inches and a small fraction to the mile, is the cadastral map of Great Britain. Strictly speaking, it is not a true cadastral map, as it does not show the actual property boundaries, these frequently running at a certain number of feet from the centre of a hedge or ditch or the face of a wall. On the Ordnance Survey, the rule has always wisely been observed of confining the detail shown on the map to that which actually exists on the ground, and leaving the definition of the property boundaries to the lawyers. The 25-inch map shows all topographical features, *i.e.*, roads, railways, rivers, hedges, fences, houses, etc., and the positions of all "bench marks" and "spot heights"; but it does not show ground forms except in so far as they may be deduced from these heights. A most important feature of this map is that it shows areas. Every plot has a number stamped on it, and its area in acres and decimals, accurately computed to the thousandth part of an acre. This map consists of 51,456 sheets, each depicting an area of $1\frac{1}{2}$ square miles or 960 acres. It is of interest to note that an acre is represented almost exactly by one square inch.

The 6-inch Map.—This map, next in point of size, is reduced from the 25-inch and shows practically the same features, but omits areas and shows ground forms by contours. It is thus both a cadastral and a topographical map. It covers the whole country.

Small-Scale Maps.—With these the general public are probably more familiar; they are, first, the 1-inch, $\frac{1}{2}$-inch, and $\frac{1}{4}$-inch to the mile. These maps are published in colours. They show all topographical features, and all hill-forms by either shading, contours or layers, or combinations of these methods. These maps are suitable for guidance when walking, cycling and driving, and they cover the whole country. Finally, there are the maps of smallest scale, the 10 miles to the inch, and the 1/M or about 16 miles to the inch. These are more in the nature of wall or general reference maps.

1/1250 Enlargements and Town Plans.—Two other classes of maps exist, namely (1) enlargements of the 25-inch map, which are made to twice the scale (1/1250) to order, and (2) town maps. Most towns in the kingdom were at one time surveyed on the very large scale of 10 ft. to the mile, London being mapped on the scale of 5 ft. to the mile. These maps, which show all the minutest details, still exist, but in these penurious days they are no longer kept up to date unless the town desires it and is willing to pay the cost.

The Work of the Survey.—The work of a properly established survey is to produce the map, to reproduce it and publish it, and to revise it. The original survey was completed many years ago for the whole of Great Britain. The reproduction comprises the drawing, reproduction by mechanical or other processes, and printing of the maps. These processes involve a great amount of subsidiary work, such as examination, proving, checking, correction of errors and so forth. Once produced, the map has to be kept up to date or it soon becomes useless. The face of the country is constantly changing; to keep maps up to date requires constant and unending work, so that the bulk of the active work of the Ordnance Survey is now, and has been for many years, that of revising. It is not uncommon at the Ordnance Survey to receive letters from infuriated tax-payers asking why they have to pay exorbitant prices for out-of-date maps, and why incompetent Government Departments which do no work are allowed to exist.

The obvious explanation is that no series of maps can be kept continually and completely up to date. Changes are constantly taking place, and the time necessary to make corrections and to print and publish causes every map to be to some small extent out of date before it is printed. If expense were no consideration, and the Ordnance Survey had an unlimited staff, it would

be possible to bring out new editions of maps every year or so. But the cost of such procedure would be absolutely prohibitive, and not in any way justified by the results. On the other hand, economy would be served by drastically reducing the staff and bringing out new editions every 100 years; but the maps would be rendered to a large extent useless. Something between these extremes is wanted, and the system on which the Ordnance Survey works is to employ a regular staff of men to go over the country systematically and revise the 25-inch map at intervals. For many years the period of twenty years has been taken as the reasonable interval to allow between successive revisions of the 25-inch map, but recently severe economies have been enforced and the strength of the Ordnance Survey reduced to considerably less than pre-war strength, making it now about 1,000. This reduction has necessitated a modification of policy, and the scheme now is to revise urban districts every twenty years and the rest of the country every forty years only. As most changes take place in the urban districts, the practical effect of the break in the continuity of revision will not usually be very serious. Small-scale maps are revised every fifteen years.

It follows from this method of working systematically over the country that the date of last revision of the sheets of the map must also vary systematically. The man who buys a sheet that has just been revised says that the Ordnance Survey is a magnificent institution, while he who, living possibly only a few miles away, in a region in which the revision is just about to be taken up, finds his map nearly twenty years old and blames the department as inefficient.

The revision of the map involves many changes besides topographical detail. Areas are all carefully revised and numbers given to new parcels; boundaries of civil divisions are checked and verified; and finally there is the revision of levels.

Ordnance Survey levels are marked on the ground by "bench marks" which are marks made on lasting structures such as walls, houses, milestones, etc. On the map the position and height of these bench marks are shown, as well as numerous "spot heights," that is, points on the surface of the ground, the position of which is recorded on the map, but not on the ground. In the period between successive revisions the levels of the spot heights are often found to have altered a good deal, owing to changes in the ground surface; while bench marks are found sometimes to have changed owing to settlement, etc., or to have disappeared owing to destruction, reconstruction, etc

A new system of primary levels, covering the whole of England, has recently been introduced. This system is based on a new and more accurate determination of mean sea level, and on a system of fundamental bench marks fixed by permanent marks in solid rock. This system will form a reliable basis from which to determine future movements of the earth's crust.

The foregoing account gives, in very brief outline, the main work of the Ordnance Survey. But there is a very large amount of incidental work, *e.g.*, the correct delineation of Government boundaries—parish, urban district, rural district, town, borough, ward, county, etc.; work done for the Admiralty, War Office, Air Ministry, etc.; the research and archæological work; the production of all the geological maps of the Kingdom from material supplied by the Geological Survey; the supply of men for active survey work in all parts of the Empire; and the training of survey personnel for war.

Staff of the Survey.—The staff of the Ordnance Survey is partly military and partly civil, comprising men of the Royal Engineer Survey Companies, ex-Royal Engineers who remain as civilians on the Survey until retirement, and civil assistants who have not been through the Army. The Survey is organised as a Headquarters at Southampton, and four Field Divisions at Edinburgh, York, Norwich and Bristol, in which the actual field work and drawing of the large-scale revision is carried out. A fifth Field Division, which is concerned with levelling operations, is located at Southampton. The actual state of revision at the present time is that the 25-inch map has been revised once, and the second revision (begun in 1906) is now in progress. The 1-inch map of Great Britain has been revised twice, and the third revision, begun in 1916, is now going on.

Historical.—The Ordnance Survey is so called because when it was first formed as a concrete body it was under the Master General and Board of Ordnance, and the name has been retained. From 1791 to 1841 the headquarters of the Ordnance Survey were in the Tower of London. In the latter year the offices of the Survey were destroyed by fire, and the Department was then transferred to Southampton, where there happened to be some barracks under the control of the Board of Ordnance.

The Survey owes its origin to the needs of the soldier. The first systematic mapping of the Kingdom began after the

rebellion of 1745, when a sketch-map of the Highlands of Scotland was put in hand by two officers, Watson and Roy. That map was interrupted by the French wars; but the idea was kept in mind, and in 1783, at the suggestion of the French, a triangulation was initiated with the object of establishing the relative positions of London and Paris. This triangulation formed the beginning of the great Primary Triangulation of the British Isles. The Ordnance Survey as such may be said to have been formally established in 1791, when the officers and men then employed under the Board of Ordnance were given special pay. The original idea was to produce a small-scale map (1 inch to the mile) only, and the first sheet of that map was published in 1801. In 1824 the Government authorised a 6-inch map of Ireland, and this date is also remarkable for the formation, by order of the Duke of Wellington, of the first three Survey Companies of Royal Engineers. The decision to make a 25-inch map for the whole Kingdom was made in 1863. The 25-inch map of Scotland was completed in 1882, and of England in 1895.

We owe a great debt to those countrymen of ours who made the big decision to embark on a complete and comprehensive survey of the Kingdom. It showed great wisdom and foresight on their part, for the history of other countries shows only too much how neglected this subject usually is—no comprehensive scheme is made, and surveys of the cadastral kind are left to be made piecemeal and in patch work. Our forefathers laid the foundations of this great national undertaking truly and well, and on that foundation has been erected an edifice which we may truly say, without boasting, is an example to the world.

LIME SURVEY IN THE WEST MIDLAND COUNTIES

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Introduction.—That the practice of liming the land has fallen into abeyance in many districts is shown by the disused kilns to be found scattered over the countryside. Evidence points to the fact that the farmers of a former generation used

very heavy dressings of lime at regular intervals, but these, unfortunately, were not always applied when there was a sufficient balance of other manures in the land, and consequently second and third dressings of lime or chalk in these cases did not give the results that were expected. Again, the introduction and common use of artificial manures, some of which were compounds of lime but not containing lime in the farmers' sense, led to these being used in many cases to the displacement of liming proper.

During the war the practice of liming revived to a certain extent, but, with the return to normal conditions, and the falling off in prices, the quantities used have again diminished, and kilns, which had become active for a short period, have dropped out of use.

Experts, dealing recently with the question of liming, have issued a warning that many soils now in cultivation are keeping up their fertility on the reserves of lime dressings applied during the last century, and when these are exhausted, the producing power of the land will be limited until the balance is again made good. On the other hand, the more progressive farmers and producers, especially in certain areas where soils are naturally deficient, recognise the importance of maintaining the lime content of their land, and are fully aware that, unless this is attended to, they will be unable to obtain full crops. One of the chief causes, however, why more lime is not used at the present time is the cost of the material, which, with the carriage, has increased very considerably since 1914, the price in some cases having risen over 100 per cent. Growers state definitely that if supplies could be obtained at more reasonable prices, greater quantities of lime would undoubtedly be used in many counties. This is a matter of vital importance to the agricultural industry, and in practically all statements of policy recently put forward by various bodies attention is drawn to the matter.

The question of utilising local deposits of limestone for dressing the land has also attracted much attention, and cases have been cited* where lime has been burnt locally for use on the farm at a figure approaching 10s. per ton. In this connection, the Ministry has made inquiry lately in the West Midland counties to ascertain from what sources the existing lime supplies were obtained, and also whether it would be

* A. G. Ruston, D.Sc.: "Lime Burning on a Yorkshire Farm." This JOURNAL, November, 1924, p. 738.

possible, from an economic point of view, to open up any local deposits for the benefit of agriculturists. The information thus obtained, with the assistance of the agricultural organisers on the spot, was of distinct interest, and the position revealed as to the practices in vogue and the facilities for obtaining supplies in the various areas would seem worth recording.

Herefordshire was the first county in which investigations were carried out, and considering all the conditions, there would appear to be few counties more favourably placed than this for utilising local supplies of lime to meet the needs of its farmers. As regards the soils of Herefordshire, it must be remembered that nine-tenths of the surface of the county lies on the Old Red sandstone formation (Devonian), the lower beds of which contain deposits of limestone known as "cornstones." Outcrops of Silurian and Carboniferous limestones also appear on the borders of the county in various spots, and in these circumstances no farm in the county is very far distant from some supply of lime. Disused kilns, where lime was formerly burnt, are to be found all over the area, especially along the valley of the Dore, which runs up past Vowchurch, and also in the vicinity of the Woolhope Valley, south-east of Hereford. In the Dore Valley, Mr. J. L. Yeomans, a well-known Herefordshire farmer, of Wilmaston Court, Peterchurch, has recently re-opened a disused kiln on his farm adjoining a quarry in the "cornstone," which burns a very pure lime suitable for agricultural purposes. The kiln is situate at the top of the hill on the northern side of the valley, and the cost of fuel and hauling to this spot is a considerable item. From figures kindly supplied by the owner, it would appear that the actual cost of production, including quarrying, fuel, labour, road repairs, upkeep of plant, explosives, interest on capital, etc., comes to about 20s. per ton of lime burnt. As Mr. Yeomans usually burns more lime than is needed for his own requirements, he allows his neighbours to draw the surplus at a price slightly above the cost of production. It is of interest to note that other owners of disused kilns in this district also expressed in conversation their willingness to re-open the kilns for the benefit of the adjoining farmers, provided that they were given some guarantee against loss on the capital outlay involved.

In the Woolhope Valley, in the neighbourhood of which Silurian limestone crops out, further disused kilns are to be found which once were in active operation. Hops are grown on

some of the soils in this valley, and a readily available supply of lime on the spot would be a boon to farmers in the vicinity. This spot is of easy access also to the sandy soils in the Ross district, which badly need lime for their successful working. The Carboniferous limestone, which appears in the southern portion of the county, also provides another supply of limestone of high quality which might be crushed and ground or burnt for agricultural use as circumstances required. Herefordshire would, therefore, seem particularly favourably situated for utilising its local supplies of lime, and if some scheme could be propounded whereby the initial risks and questions as to finance for a start could be overcome, there seems every prospect that as farmers recognised the advantages of cheap supplies of lime at their doors, the schemes would become self-supporting and fresh deposits would be opened out.

The Lime Position in Shropshire.—In this county the surface falls into two well-defined areas: (*a*) the northern Triassic "plain," which passes through the county from east to west, the arable soils of which are highly farmed and are generally very deficient in lime; (*b*) the southern and western portions of the county, which are undulating in character and largely devoted to grass and stock-rearing. The older rocks occur in this latter area, including the Silurian, which in places gives rise to hill ranges, as in the neighbourhood of Wenlock, and there is a plentiful supply of limestone. Owing to the nature of the farming, liming is not practised to any extent in this portion of the county. In the "plain" area of the northern portion of the county, practically no deposits of limestone are to be found suitable for conversion into lime, and this district is therefore dependent on rail-borne supplies brought from a distance.

It will thus be seen that the question of liming in Shropshire really resolves itself into finding a good supply of pure rail-borne lime for the "plain" area in the north and east, where, as stated, there are practically no natural deposits of limestone to burn. In this connection, it is interesting to note that there is an almost inexhaustible supply of good limestone (Carboniferous) in the neighbourhood of Oswestry and also at Chirk, just over the Welsh border, which is of easy access to the plain area both by rail and canal. There are also good supplies of limestone (Wenlock) available from the quarries along Wenlock edge. In these circumstances it would seem to be to the advantage of farmers to form contracts, through their

associations or trading societies, for supplies of lime from these sources, where the operations are carried out on a large scale and the labour of hauling and burning is reduced to a minimum. In south and west Shropshire, as already stated, the question of liming is not so important, although in special cases, as in the vicinity of Craven Arms, where a certain amount of land is under the plough, it might be a feasible proposition to open up and burn one or more of the local deposits of limestone for the benefit of adjoining farmers, as has been done on the Delbury Hall Estate.

Other Counties in the West Midlands include Somerset, Stafford, Gloucester, Warwick and Worcester, and the lime problem, especially in those districts where the soils are naturally deficient in lime, and local deposits of limestone suitable for burning are not always handy, seems to resolve itself into the question of obtaining a good rail-borne supply from the nearest source. Where there are up-to-date works, centrally situated, as in Somerset and Gloucester, inquiries seem to show that supplies can be obtained from these sources at more reasonable figures in present circumstances than if attempts were made to open up and burn local deposits on a small scale.

Where the sources of supply, however, are at a distance, the rail rate, added to the cost of the material, in many instances makes the price excessive to farmers when delivered at the local stations, and this naturally tends to restrict the use of lime on soils where it is really required. To obtain some relief in these cases, the best line of action would seem to be for farmers to bulk their orders and thus obtain special terms through their associations. This has been done to a certain extent in some of the counties referred to, but it is always difficult to get farmers to take the initiative in these matters. On the other hand, in the more remote districts of some of the counties named, where rail facilities are bad and a deposit of limestone exists, it would probably be a paying proposition for two or three farmers to combine together to open a disused kiln for their mutual benefit, but in such cases the initiative must come from the farmers themselves, who are to benefit by such a scheme.

In conclusion, it may be noted that the Bath and West and Southern Counties Society, aided by the Advisory Staff of Bristol University, are carrying out certain tests with the object of ascertaining whether local deposits of limestone can be profitably crushed on the spot for the benefit of landowners

and farmers who wish to lime their land. For this purpose, trials are being arranged with certain types of crushing machines, and it will be of interest to follow the results of these experiments.

METEOROLOGY AND AGRICULTURE

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CLIMATE, definable as the average of meteorological conditions over a long term of years, has a predominant influence upon agricultural production. As crops differ in their individual demands for warmth, rainfall, and sunshine, so an excess or deficiency in the requisite quantities of these essentials causes injury and possibly complete failure. Not less important than the requisite seasonal quantities of these meteorological elements is their incidence in the life of crops, since as a general rule there are critical periods or stages in growth at which certain quantities of rain, sunshine, or warmth are particularly necessary. Climatic conditions are often found in "zones," the effect upon vegetation being most clearly exemplified in continental regions, such as North America, with its cotton, maize, and wheat belts. In England, as a result of the climatic differences, corn crops are found mainly in the eastern and grassland in the western counties.

In addition to their direct action upon crops, meteorological elements have an indirect influence, bearing chiefly upon cultural operations and upon the pests and diseases to which crops are subject. Obviously, if ploughing, seeding, and harvesting operations have to be undertaken when weather conditions are adverse, the chances of a successful crop are lessened. Temperature and humidity at various periods in the life history of insect and fungus pests are all-important to the development of these pests, the effect being accentuated if at the same time the weather conditions adversely affect the growth of the host crops or bring them to a susceptible state at the right moment from the point of view of attack. The weather, also, indirectly influences crop growth through its effect on the soil, rainfall above a certain amount leading to the washing away of plant nutrients.

To a limited extent it is possible to modify climatic influences locally, *e.g.*, by draining marsh land ; by cutting down forests ; by irrigation to counteract deficiency in rainfall ; and by the use of smoke screens, artificial heat or flooding to guard against frost. Certain crops, also, such as glasshouse crops, can be grown profitably under artificial conditions that make them almost independent of climate. In general, however, it is true to say that there is no possibility of so changing climate as to render it more suitable to particular crops. Such crops and their varieties must be chosen, and farming operations so ordered, therefore. as best to support the existing climatic conditions.

Use of Meteorological Observations in Practical Agriculture.— The crops and operations customary in any given district have been adopted, presumably, after long experience based on past successes and failures. It is impossible, however, to be certain that such crops and operations are indisputably. the best, because one cannot be sure that all alternatives have been tried, a consideration which gains in importance when it is remembered that modern agricultural science is ever placing fresh discoveries before the farming public. The practical man should know within a reasonably short time what farming practice can be adopted, what new crops can be grown, and which of the discoveries made by research institutes can be put into operation in his own particular case with chances of success. As a recent example may be cited the introduction of the sugar beet crop, in the case of which the weather conditions which favour good yield and quality must be known and compared with those obtaining in a district in which its introduction is contemplated.

Careful and detailed data relating to meteorological conditions experienced throughout the life of crops, and their effect on growth, are thus required if new agricultural practices and the results of agricultural research are to be given their full value.

Use of Meteorological Observations in Agricultural Research. —A study of meteorological conditions is necessary for the carrying out of research. The *plant breeder*, for example, desires to know the critical stages in a plant's growth so that he may breed varieties with characteristics that will render them more resistant at those critical periods (whether to direct adverse weather conditions or insect and pest attacks),

or characteristics that will predispose those critical periods to occur at times when weather conditions are likely to be favourable. An outstanding example of fitting a crop to climatic conditions is afforded by the breeding of "Marquis" wheat in Canada ; this wheat matures a few days earlier than standard varieties grown up to the time of its introduction ; these days were critical days, however, and the wheat could be grown in districts with a risk of earlier winters, so that a great expansion of the area under the crop in that country resulted. For the same reason "Marquis" escapes much of the rust which used to ravage " Red Fife " and its other predecessors.

The *worker on soils and manures* desires to know how, with any given soil, the effect of manures both on yield and quality of crop varies with meteorological conditions, so that he may give advice to the practical farmer in accordance with the weather experienced and that to be expected from a study of foregoing seasons. Thus from a study of soil and weather the soil worker may be able to advise that a dressing of nitrogenous manure applied for wheat in winter will need to be repeated in spring ; that with the prospect of a large spring rainfall muriate of potash can be equally well applied to potatoes as sulphate of potash ; that, as the summer is wet, basic slag may be applied with every prospect of increased keep from pastures in the autumn.

The *soil physicist* desires to know the effect of meteorological factors on those soil conditions (*e.g.*, soil moisture, plasticity, cohesion, etc.) on which soil tilth depends, so that he may assess the relative efficiency of different cultural operations, both from the practical and economic aspects. He also needs this information to supplement and check his laboratory investigations on the physical properties of soils.

Apart from its intrinsic value to soil science, this knowledge is of the greatest importance to the *agricultural engineer*, as it enables him to base his implement designs on definite information in place of empirical observations. Detailed local data regarding rainfall, humidity, temperature, sunshine, and wind are directly of value to the agricultural engineer in investigations of the use in agriculture of water and wind power and of drying apparatus.

The *plant pathologist* is concerned with the effect of climatic conditions on insect and fungus pests in order that control measures may be devised, and, as a result, and with observa-

tions of meteorological conditions at any place and time, practical growers may be advised as to the necessity, or otherwise, of adopting these measures. The value of observations on the effect of weather on outbreaks of epidemic diseases of plants is shown by work in Europe and America. In France and Italy it has been found possible, by careful meteorological, crop and pest observations, successfully to forecast outbreaks, and an organisation has been set up both at Montpellier and at Turin for the purpose of warning growers when to spray.

Considerations such as the foregoing show how necessary it is for the advancement, both of the practice and science of agriculture, that careful and detailed meteorological observations should be carried out concurrently with observations on the growth, yield, and quality of crops, their response to manures, their resistance to attacks of insect and fungus pests, etc.

Use of Meteorological Observations in Forecasting Yields.—Observations of meteorological data, on the one hand, and of crop data on the other, may prove to be of value, among other purposes, for that of forecasting yields of crops. Statistical methods have been evolved whereby, given sufficient data of both kinds, the two can be correlated and the effect of meteorological elements, singly or in combination, on the crop yields ascertained. It may therefore be possible in future, by using the meteorological data collected in any season and applying " correlation coefficients," worked out by statisticians, to estimate the probability that the crop yield will be above or below a certain amount. This aspect of agricultural meteorological work is the one above all others that has made a special appeal abroad. The value of forecasts is likely to be increased proportionately to the length of time that they can be made in advance; the date at which they can be made depends, of course, largely on the times of critical periods in the crop's life. One aspect of crop weather forecasting, which has received some attention in the past, is that of weather cycles or periodical repetition of weather conditions; such cycles are stated to have been discovered, and the search for fresh ones is being pursued. Other things being equal, repetition of meteorological conditions may be expected to lead to reproduction of agricultural phenomena.

Agricultural Meteorological Work Abroad.—This country has hitherto been very much behind others, notably Russia,

the United States, and France, in the study of agricultural meteorology. A Bureau of Agricultural Meteorology was established in Russia as far back as 1894 for the organisation of agricultural and horticultural meteorological stations to determine the relation of weather to crop production, and by 1912 observations were kept at eighty-one experiment stations. An Agricultural Meteorology Division of the United States Weather Bureau was formed in 1916 for the purpose of organising agricultural meteorological stations at the chief agricultural experiment stations of the country. A similar scheme was begun in Canada in 1915. Stations on the Russian plan have been established quite recently in Italy. In France an "Agricultural Physics and Meteorology" service was established in 1912, and when, in 1921, the new French agricultural research organisation was set up, agricultural physics and meteorology stations were made an integral part of this organisation; much practical use has been made in France of work in which meteorological data have been related to outbreaks of plant diseases. In Hungary and Japan agricultural meteorological organisations have been set up with the express task of furnishing forecasts of crop yields. In Brazil an agricultural meteorological service was formed in 1921; agricultural meteorological stations have been established in that country both at agricultural experiment stations and at climatological stations.

Agricultural Meteorological Work in this Country.—Except for isolated pieces of research on, for instance, the correlation between the weather and the yield of wheat, by such investigators as Mr. R. H. Hooker and Sir Napier Shaw, and work by Dr. R. A. Fisher on the effect of weather on the yields of the experimental plots at Rothamsted, no serious attention was given in this country to agricultural meteorology until 1922; in that year a committee, appointed by the Agricultural Research Council, under the chairmanship of Sir Thomas Middleton, suggested that studies of three types should be encouraged in this country, viz.:—

(1) General studies of the correlation between weather and crops in a particular area, by examination of the data relating to crop yields and meteorological conditions in that area over a number of years, with the object of increasing the accuracy of crop estimates.

(2) The organisation by the Ministry of Agriculture on a uniform plan of the collection of observations on the state of crops (autumn and spring sown cereals, root crops, potatoes, grass,

and horticultural crops), and the incidence of insects and fungi, accompanied by meteorological observations at agricultural experiment stations in all parts of the country.

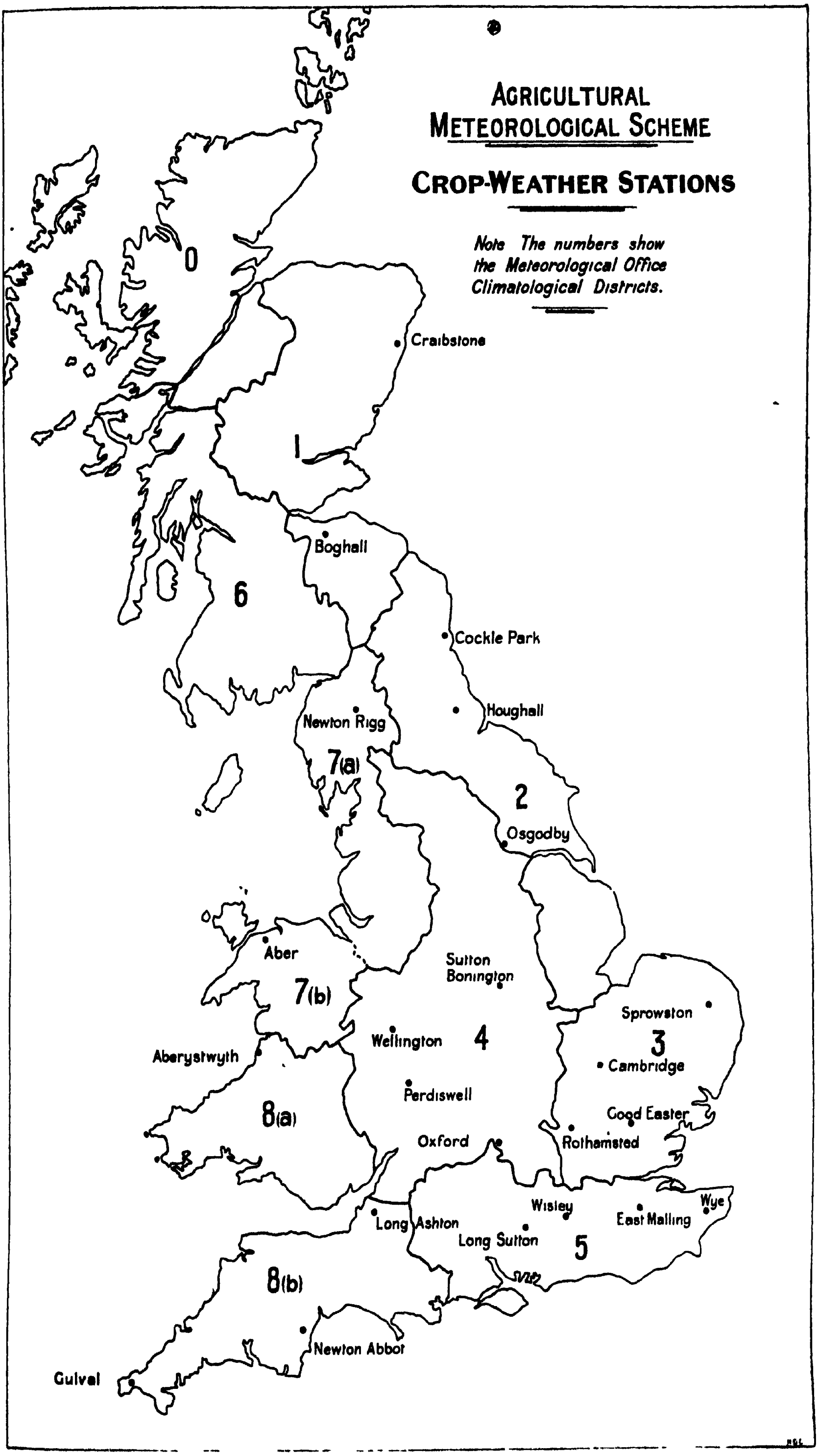
(8) The carrying out of special intensive studies of the reaction of crops to weather.

The committee's recommendations were adopted by the Agricultural Research Council, and a conference of representatives of education and research, under the chairmanship of Sir A. D. Hall, drew up a scheme to carry out the committee's second recommendation.

The British Agricultural Meteorological Scheme.—The following are particulars of this scheme, in which the Ministry of Agriculture, the Board of Agriculture for Scotland, and the Meteorological Office are jointly concerned. Twenty-three agricultural meteorological stations have been set up at the following places: Craibstone, Boghall (Scotland, E.); Cockle Park, Houghall, Osgodby (England, N.E.); Sprowston, Cambridge, Rothamsted, Chelmsford (England, E.); Sutton Bonington, Wellington, Worcester, Oxford (Midland Counties); Wisley, East Malling, Wye, Long Sutton (England, S.E.); Newton Rigg, Aber (England, N.W.); Aberystwyth, Long Ashton, Newton Abbot, Gulval (England, S.W.). These stations are shown in the map on page 327. The stations are situated at agricultural research institutes, agricultural colleges, crop testing stations, or county council farm institutes. The observations taken are of four kinds: (1) meteorological, (2) agricultural, (3) horticultural, (4) phenological.

Meteorological Observations.—All the stations take the meteorological observations; these are maximum and minimum air temperature, from which mean and "accumulated" temperature is computed; rainfall; sunshine; soil temperature (2 ft., 8 in., 4 in.); humidity (dew point and relative humidity); wind; and general weather observations. These observations are taken once daily, at 9 a.m. G.M.T., with the exception of humidity and soil temperature, the data regarding which are taken three times daily, at 9 a.m., 3 p.m., and 9 p.m.

In addition, certain stations (*e.g.*, Rothamsted and Cambridge), which have been equipped with self-recording instruments, take the meteorological observations in greater detail. These centres are engaged in researches directed towards improving the reliability and usefulness of the routine observations.


AGRICULTURAL
METEOROLOGICAL SCHEME
CROP-WEATHER STATIONS
Note The numbers show the Meteorological Office Climatological Districts.
0
Craibstone
1
Boghall
6
Cockle Park
Houghall
Newton Rigg
7(a)
2
Osgodby
Aber
Sutton Bonington
7(b)
Sprowston
3
Wellington
4
Cambridge
Aberystwyth
Perdiswell
8(a)
Good Easter
Rothamsted
Oxford
Wisley
East Malling
Wye
Long Ashton
Long Sutton
5
8(b)
Newton Abbot
Gulval

Agricultural Observations.—Most of the stations take observations on agricultural crops for correlation with the meteorological data. These observations are taken on selected fields in the neighbourhood of the meteorological station, and relate to the same varieties of crops each year. Those specified so far are as follows :—

Corn Crops (Wheat, Oats, Barley).—Variety, soil characteristics, previous cropping, manuring, cultural operations, date of sowing, date of appearance above ground, date of breaking into ear, date of flowering, date of harvest, the yield per acre of corn and straw and the bushel weight; attacks of diseases and pests. (A phenomenon between the date of appearance above ground and the date of breaking into ear is to be specified later. In the case of oats this intermediate stage is when the majority of plants in the field show four leaves.)

Root Crops (Turnips, Swedes).—Variety, soil characteristics, previous cropping, manuring, cultural operations, date of sowing, date of appearance above ground, date of breaking into rough leaf, yield per acre (tops and roots separately), attacks of diseases and pests.

Grass (Meadow Hay).—Soil, manuring, cultural operations, date of flowering of (*a*) sweet vernal, (*b*) perennial rye grass, date of cutting, yield per acre of hay ; attacks of diseases and pests.

Crop Testing Stations.—In the case of agricultural crop observations, the agricultural meteorological scheme has been combined with a scheme for the testing of varieties of farm crops. Under the latter scheme, six stations have been established in different climatic districts of the country for the purpose of testing the yields of new varieties of cereals, roots, etc., in comparison with standard varieties for those districts ; at such stations it is obviously necessary to take full and accurate measurements of the meteorological conditions under which the crops grow, in order, if the new varieties fail, to ascertain whether, and which, meteorological conditions are unfavourable to their growth, or, if they succeed, to be enabled to recommend them to growers under certain meteorological conditions.

Horticultural Observations.—Twelve stations take observations on horticultural crops for correlation with meteorological data. These stations are classed as either principal or secondary, according to whether special plots are set aside for the purpose of observations or not. Special plots of peas are kept by both principal and secondary stations. Special plots of fruit are kept by principal stations ; at secondary stations existing

trees and bushes are used for the purpose of observations. The special plots consist of :—

(1) *Apples* (Worcester and Bramley's Seedling).—Four bush trees of each variety. On Doucin (Type 2) stock with 2 ft. legs.

(2) *Plums* (Victoria).—Four half-standard trees.

(3) *Blackcurrant* (Boskoop Giant).—Ten bushes inter-planted.

True stocks of these varieties are supplied from the East Malling Research Station. The observations on these and on peas are as follows :—

Apple (Worcester and Bramley's Seedling) and *Plum* (Victoria).—Date of flowering, duration of blooming season, date of June drop, date on which the bulk of the fruit is ripe, crop from each tree, attacks of diseases and pests, duration of defoliation period, shoot growth.

Blackcurrant (Boskoop Giant).—Date of blossoming, date when all currants are fully ripe, crop from each bush and total weight of fully ripe currants, duration of defoliation period, number of "big buds" during first week in January, attacks of diseases and pests.

Peas (Gradus).—Date of appearance above ground, height of peas at intervals of seven days, date of first open flower, date when first picking would be possible, average height of plants at completion of growth, volume of dry peas harvested, attacks of diseases and pests.

Fruit Testing Stations.—In the case of horticultural crop observations, this scheme has been combined with a scheme for the testing of new varieties of fruit trees, under which stations are being established in different climatic districts of the country ; this scheme is a counterpart of the crop testing scheme which has been explained above.

Phenological Observations.*—In addition to the observations on plant growth and plant pest appearance, required under the agricultural and horticultural parts of the scheme, various stations have responded to an invitation to collect additional phenological observations : these observations are the date of flowering (or other growth stage) of any or all of 21 wild plants, shrubs, and trees. The observations are made year after year on the same bush, plant, or association of plants, growing under average conditions (*i.e.*, not very sheltered or very exposed), well established. In selecting the plants to be observed, preference is given to species growing in the neighbourhood of stations where observations under the Agricultural Meteorological Scheme are being recorded,

* Phenology is that branch of meteorology which treats of climatic influences on certain recurrent phenomena of animal and vegetable life.

and which are familiar to farmers and, possibly, to other individuals.

It may be explained that the effect of all the meteorological elements making up the character of the season can be expected to be summed up in such plants as have been selected: these plants may be termed indicator plants, and they show whether the season is early, normal, or late. Observations of this kind have been summed up in the United States in a "bio-climatic law" of latitude, longitude, and altitude, to the effect that the climatic variation in plant development is some four days to each degree of latitude and to each five degrees of longitude, and to each 400 feet of altitude, the phenological dates being later northward, eastward and upward in the spring and early summer, and the reverse in the late summer and autumn. Good use has been made of these phenological observations in regulating farming operations and in combating pests (*e.g.*, Hessian fly).

In addition to the data specified above, diaries are kept at the stations for the purpose of recording day by day the observer's own impressions of the effect of weather on crops. When the material (meteorological and biological), collected under the Agricultural Meteorological Scheme, is available in satisfactory form for a sufficient length of time, arrangements will be made for it to be subjected to rigorous statistical examination with the object of determining the effect of meteorological conditions on the growth of crops. It is hoped, also, to place freely at the disposal of investigators interested in one or more of the various aspects of the work, all the material available. During the time that the scheme has been in operation, monthly reports have been issued summarising the data collected at the various stations, and copies of these reports may be obtained free on request from the Ministry of Agriculture and Fisheries. It is further hoped that the observers at the different stations will keep in mind the objects for which the observations are made, and utilise them whenever opportunity occurs in their own districts. Exceptional occurrences, like long droughts, heavy floods, unusual lack of sunshine, etc., must express themselves on crops and stock, and may produce effects after long intervals that an ordinary monthly comparison will not disclose. There is also the question of the recovery of crops from adverse conditions, which cannot very well be scheduled but may be of real importance and interest to those who are in daily touch with the facts.

The agricultural meteorological scheme of the Ministry is in the charge of a committee, of which representative meteorologists and agricultural biological and statistical workers are members.*

Effect of Weather on Animals.—The writer has failed to discover that much attention has yet been paid, in foreign agricultural meteorological schemes, to correlating the meteorological data available with data relating to animal husbandry. Climate has obviously been as important in determining the fauna of various districts as it has the flora. Obviously, crops have an important influence on the animals feeding on them, so that climate will affect animals indirectly through crops. It must, also, have a direct influence. Temperature and humidity, necessarily, have considerable effect on the *health* of animals and on the pests to which they are subject. Temperature must affect the *rationing* of animals for the production of meat and milk, and weather conceivably affects the composition of milk; the effect of sunlight, even, has to be considered in connection with the feeding of animals. And, as regards *breeding* questions, it seems that meteorological conditions influence fertility (at least of sheep); and artificial lighting (quite apart from effects on health and rationing) may also influence fecundity. The effect of meteorological conditions on the animal husbandry of the country appears therefore to offer a wide field for study.

NOTE.—No attempt has been made in this article to deal with the supply of weather forecasts to farmers; a special leaflet on this subject (*The Weather and the Farmer*) may be obtained free on application to the Ministry of Agriculture and Fisheries.

The writer desires to express his indebtedness to members of the committee for their kindness in perusing and making suggestions regarding this article.

* The committee is composed of: Sir Napier Shaw, F.R.S. (Chairman), Sir Thomas Middleton, K.B.E., C.B., etc., Prof. V. H. Blackman, F.R.S., Mr. R. Corless, M.A., Dr. R. A. Fisher, M.A., Mr. J. C. F. Fryer, M.A., Mr. R. H. Hooker, M.A., Mr. R. G. K. Lempfert, C.B.E., Mr. H. G. Richardson, M.A., B.Sc., Mr. H. V. Taylor, A.R.C.S., Mr. W. R. Black, B.Sc. (Secretary).

TRIALS OF TAR-DISTILLATE WASHES IN EAST ANGLIA

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THE introduction into this country of the so-called "carbolineum" water washes has brought about a big change in the routine spraying of orchards; it is, indeed, the most important addition to our knowledge of the control of fruit pests that has been made for some time. The term "carbolineum" is somewhat misleading, as the name has been used for a number of years to describe certain proprietary wood preservatives. In *Technical Methods of Chemical Analysis*, Vol. II, Pt. II, pp. 833-834, G. Lunge and C. A. Keane give the following information concerning it:—

> "Carbolineum" is the name given to an oil which is used for painting on wood to protect it from rotting, and recently, also, for protecting trees. It consists of heavy coal tar oil, so-called green oil (filtered anthracene oil), to which small quantities of other wood preservatives are sometimes added, such as zinc chloride or resins. It is usually of a brown colour, but it is occasionally specially coloured by the addition of aniline dyes soluble in oil. "Carbolineum Avenarius" (trade mark) is a product manufactured by R. Avenarius (German Patent 46021) by the action of chlorine on the oil. "Carbolineum" is often imitated by substituting other mineral oils, even oil tars, which do not, however, exert so powerful a preservative action as anthracene oil.

According to Holde (*Mineralöle und Fette*, 1905, p. 397), the oils described as carbolineum for impregnating wood are, as a rule, greenish black, heavy, coal tar oils. . . .

The commercial varieties of carbolineum possess the following properties:—

	Carbolineum Avenarius	Ordinary commercial carbolineum
Specific Gravity at 15° C.	1·128	1·075/1·130
Distillation begins at .. .. (over)	200° C.	200°/270°C.
Distillation up to 200° C. Vol. per cent.	0	Traces
,, ,, 200° C. to 230° C. ,,	0	4/5
,, ,, 230° C. to 270° C. ,,	10	2/15
Residue	Oil	Oil

Ordinary carbolineum is unsuitable for spraying fruit trees, but, during the last two or three years, a number of winter washes (sometimes known as carbolineum washes) have been made from tar distillates and placed upon the market. These washes would be better named tar-distillate washes. In conse-

quence of the large number of these proprietary tar-distillate winter washes that are now being manufactured, the grower is faced with the great difficulty of deciding which of them to use. Since it is obvious that a range of similar articles manufactured by different firms and under varying conditions may not all approach the same standard of uniformity, we have tested a number of the best known of these various washes. The following experiments were carried out in conjunction with county organisers to compare these washes:—

Experiments in Cambridgeshire: *Series I.*—Carried out in conjunction with Mr. A. T. Paskett, Horticultural Superintendent for Cambridgeshire. In this series, an orchard, kindly lent by Mr. W. Unwin of Histon, was sprayed on February 12, 1925, with eleven proprietary winter washes, which were "Carbokrimp," * Chafers No. 1 Winter Wash,* Ialine Tar Oil Winter Wash,* "Mortegg," * and seven other washes which we labelled A, B, C, D, E, F, G. A headland pump, working two nozzles adjusted to give a coarse spray, was employed.

There were three rows of plums and three of apples, arranged as follows:—

> "Rivers" Plum, "Chivers" Seedling Apple, "Allington" Pippin (this variety for half the length of the row, the remainder being "Jolly Miller"), "Stirling Castle," and two rows of "Victoria" Plums.

There were fifteen plots, each plot being two trees deep across the six rows mentioned above, or twelve trees per plot, except in two cases where the plots contained three rows of trees. Appropriate controls were left. Observations were kept on these plots throughout the season and estimations of the amount of leaf curl caused by aphides and the damage caused by caterpillars were made.

Beside these estimations, an analysis of the insect population of the trees in the various plots was made in May. This was done by holding a beating tray underneath the trees as they were jarred and shaken. The approximate numbers of the various pests present on the tray were then tabulated. In Table I, Col. i, will be found the percentage of leaves curled by aphis on trees sprayed with the various washes.

Experiments in Essex: *Series II.*—Through the kindness of Messrs. W. Seabrook & Son, Ltd., Mr. R. Hart, the Instructor

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* Permission has been obtained, from the firms supplying these washes, to publish the results.

in Commercial Horticulture for Essex, was enabled to carry out a somewhat similar trial. This consisted in the application of six washes on February 26-28 :—Carbokrimp, Mortegg, and A, B, D, and G. The general arrangement of this series was as follows :—

In the block of trees taken there were ten rows, all apples, the varieties being "Cox's Orange Pippin" (5 rows), "Worcester Pearmain" (4 rows), "Devonshire Quarrenden" (one row). Only the alternative rows were sprayed, the intervening rows serving as efficient controls, and ensuring that there was no risk of one spray being accidentally blown upon trees sprayed with another wash. Observations and estimates were made by Mr. R. Hart and Mr. H. Fraser, from April 9 to May 11, 1925.

One mark was recorded for a small amount of aphis or caterpillar; two marks where aphis or caterpillar were easily found; three marks where the tree was badly infected with either aphis or caterpillar. The caterpillar figures refer chiefly to winter moth caterpillars and not Tortricids. The results are tabulated in Table I, Col. ii, for aphis damage, and Table II for caterpillar damage.

Experiments in the Isle of Ely: *Series III.*—This series was carried out by Mr. W. G. Kent, Horticultural Superintendent, Isle-of-Ely County Council, in an orchard kindly lent by Mr. A. Shuker. The following tar-distillate washes were applied on January 26 :—Carbokrimp, Mortegg, and washes C, G, and H. Two rows of "Lane's Prince Albert" apples trees, 18 years old, were selected, as nearly comparable in size and density of growth as could be obtained. The method adopted for recording results was to examine 2,000 blossom trusses on at least six trees of each plot, making a record of every truss showing signs of damage by caterpillar to which was attributed :—

(1) Gnawed blossom-buds or stalks, or buds eaten off entirely.
(2) Holes eaten in the foliage surrounding each blossom truss.
(3) Blossom buds prevented from opening by early attacks of caterpillar, which bored into them while closed or only partially open.

The results are tabulated in Table III.

Experiments in Herts: *Series IV.*—Mr. C. E. Hudson, of the Hertfordshire Institute of Agriculture, carried out trials with Carbokrimp and washes A and G. The trees sprayed were "Rivers" plum, and spraying took place on January 31.

At a later date the percentage of leaves curled by aphis was estimated independently by two observers. The results on being compared were practically identical. The results are tabulated in Table I, Col. iii.

TABLE I.—SHOWING THE RELATIVE ATTACK OF APHIS.

Spray Treatment Per cent.	(i) Cambs. (Plums) Sprayed Feb. 12 Amount of leaf curl caused by aphis	(ii) Essex (Apples) Sprayed Feb. 26-28, Intensity of attack of Rosy Apple aphis*	(iii) Herts (Plums) Sprayed Jan. 31 Amount of leaf curl Per cent.
Carbokrimp 7½	None. Very few	1†	1
Chafers No. 1 Winter Wash, 10	None	—	—
C. Ialine Tar Oil Winter Wash, 3½	Few	—	—
Mortegg, 7½	None. Very few	1	—
A, 7½	Few	12	30‡
B, 7½	2-3 per cent.	17	—
C, 5	5 „	15	—
D, 5	5		
E, 3½	5		
F, 7½	20-25		
G, 7½	35-40	26	10§
Untreated	25-45	30 (Maximum)	50-60

* Method of estimation is shown on page 334.
† At 10 per cent. ‡ At 5 per cent. § At 8½ per cent.

TABLE II.—RELATIVE EXTENT OF CATERPILLAR (WINTER-MOTH) DAMAGE IN ESSEX.

Spray Treatment (Feb. 26-28, 1925) Per cent.	Intensity of Attack*
Carbokrimp, 10	2
Mortegg, 7½	2
A, 7½	11
B, 7½	11
D, 7½	10
G, 5	5

* Method of estimation is shown on page 334.

TABLE III.—RELATIVE EXTENT OF CATERPILLAR DAMAGE AT WISBECH (Sprayed, January 26, 1925).

Spray treatment and strength Per cent.	Number of blossom trusses examined	Number of blossom trusses damaged by caterpillar	Damaged trusses Per cent.
Carbokrimp, 10	2,000	256	12·8
Mortegg, 10	2,000	428	21·4
C, 7½	2,000	557	27·8
G, 10	2,000	646	32·3
H, 10	2,000	727	36·3
Unsprayed	2,000	928	46·4

The 1926 observations are not yet completed, but the following is a summary of our present data.

Carbokrimp, Chafer's No. 1 Winter Wash, and Ialine Tar Oil Winter Wash at 6 per cent. concentration have given satisfactory control of aphis on plums. At a concentration of 6 per cent. Carbokrimp considerably reduced the damage caused by caterpillars on plums near Cambridge. Ialine and Mortegg at 6 per cent. also considerably reduced the caterpillars on plums, but to a rather less extent. Chafer's No. 1 reduced the caterpillar damage rather less than Ialine and Mortegg.

In experiments carried out at Wisbech in conjunction with Mr. W. G. Kent, a 10 per cent. concentration of Carbokrimp caused a marked reduction in the caterpillars (mainly Tortricids) on apple trees. Ialine and Mortegg at 10 per cent. also considerably reduced the caterpillars, but to a less extent.

Chafer's No. 1 reduced the caterpillar damage rather less than Ialine and Mortegg.

From the preceding figures, it is obvious that the different washes gave very different results in the control of leaf-curling aphis and rosy apple aphis. Some washes gave practically complete control, others gave fairly good controls, others moderate control, and others very little control. The figures also show that some of these washes were much more successful than others in reducing caterpillars. Observations also show that some of these washes gave practically a complete control of apple sucker, whereas others gave only partial control in varying degrees, or very little control.

One peculiar feature of these tar-distillate washes is that, although some of them will control aphis and check caterpillars, we have no evidence that any of them will check the red spider (*Oligonychus ulmi* C. L. Koch), which was prevalent on plums and apples in the Eastern Counties in 1925. On the contrary, we have evidence that the red spider may be worse on sprayed trees than on unsprayed trees. In one orchard five rows of "Bramley's Seedlings" left unsprayed were comparatively free from red spiders, whereas neighbouring "Bramley's Seedlings" sprayed with Carbokrimp were badly attacked by red spider late in the season. The previous history of all these trees was said to be practically similar.

Injury to Fruit Buds.—One very important practical point was demonstrated in the above series of experiments, *viz.*, that the date of application of the wash is of extreme importance. The makers of most of the above washes say that spraying must be done *when the buds are dormant*.

In the Hertfordshire trials, the plums were sprayed on January 31, and no injury was apparent. In the Cambridgeshire trials, the spraying was done on February 12, when the buds looked as if they had just begun to swell. As a result of the spraying many of the trees lost over 90 per cent. of their fruit buds, whereas some of the washes caused no injury. In one orchard, "Belle de Louvain" suffered the most damage, "Victorias" and "Yellow Pershores" also suffered badly, but the injury to "Czars," "Monarch," and "Purple Pershores" was not serious.

No blame attaches itself to the makers of the washes for this injury to the buds in the experimental trials, as their instruction to spray when the trees were dormant was not followed.

Many varieties of plums were sprayed with some of the above washes as recommended in November, December, and January, 1925, without any apparent injury. These included several of those which caused damage at Histon. In 1926, spraying towards the end of January with 6 per cent. strengths of several of the above washes on "Czars," "Monarchs," and "Victorias," caused no apparent damage to the buds. In the above experiments, no injury was noticed on the apples, which, of course, remain dormant much longer than the plums.

In some districts, and notably in parts of the Wisbech area, some of the "hard" waters available for spraying are not suitable when used alone with some of these tar-distillate washes, as the emulsification of the mixture breaks down and a brown oily substance separates out. When mixed with water, a tar-distillate wash should give a milky fluid with practically no separation of dark oily drops. Experiments with some of these waters show that the emulsification was retained by the addition of about 0·2 per cent. of gelatine (or the equivalent amount of glue or size).

In addition to the above experiments, other trials have been organised and a few other washes tested. We have also made observations on trees sprayed by various growers. Like the experiments, these observations show that some of the washes when properly applied were very satisfactory for controlling aphis and apple sucker and reducing caterpillars, whereas other washes were unsatisfactory for this purpose.

Effect on Growth—It was very noticeable, in 1923-24, that trees sprayed with some of these washes produced much more luxuriant foliage, especially in the case of plums, and that these trees retained their improved appearance for some time.

In 1925, a comparison was made of the weights of leaves from sprayed and unsprayed trees and the results are shown in Table IV.

TABLE IV.—WEIGHT OF LEAVES ON SPRAYED PLUMS.

Spray (per cent.)	Date of observation	District	Variety (Plums)	No. of leaves	Av. Wt. per leaf (Grs.)	Increase of sprayed leaf on control. (per cent.)
Carbokrimp 10	21.5.25	Cambs	Czar	140	0·308	41
Untreated ..	21.5.25	,,	,,	130	0·218	
Carbokrimp 10	23.5.25	,,	,,	620	0·311	42
Untreated ..	23.5.25	,,	,,	704	0·219	
Carbokrimp 12	8.7.25	,,	,,	500	0·491	20
Untreated ..	8.7.25	,,	,,	500	0·410	
Carbokrimp 10	24.7.25	,,	,,	250	0·471	53
Untreated ..	24.7.25	,,	,,	250	0·308	
Carbokrimp 12	24.7.25	,,	,,	250	0·384	7
Untreated .	24.7.25	,,	,,	250	0·356	
Untreated ..	23.5.25	,,	Victoria	427	0·321	
ChafersNo.1 10	23.5.25	,,	,,	317	0·622	94
Carbokrimp 7½	23.5.25	,,	,,	383	0·548	71
Mortegg 7½ ..	23.5.25	,,	,,	343	0·522	63
G 7½	23.5.25	,,	,,	385	0·498	55

From the above figures it will be seen that, in the case of plums, spraying with tar-distillate washes considerably increased the weight of the individual leaves, which were darker green in colour. In the case of apples, the figures did not show any increase in the size of the leaves as a result of spraying.

Conclusions.—Some tar-distillate washes gave practically complete control of leaf-curling plum aphis and rosy apple aphis in 1925 and 1926 (*see* Table I). Other washes gave fairly good control; others moderate control; and others very little control.

Tables II and III show that some washes reduced the caterpillar damage more than others.

No evidence was found that Red Spider (*Oligonychus ulmi*) was reduced by tar-distillate washes.

Plums can only be sprayed with safety with some tar-distillate washes when the buds are dormant. If sprayed when the blossom buds are swelling, these may drop off.

Special precautions must be taken with waters which will not give a stable milky fluid when mixed with the concentrated wash.

Plum leaves were heavier on trees sprayed with certain "tar-distillate" washes.

THE APPLE FRUIT MINER* AND THE APPLE FRUIT FLY†

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In some parts of the world the apple fruit miner is a serious apple pest, notably in North Europe, in parts of Canada, and occasionally in Scotland. It is also reported from Japan, and is very probably a native of all the cooler climates of the northern hemisphere in which the mountain ash or species of wild crab occur. The insect is not uncommon throughout England and Wales, but is seldom, if ever, a pest of much importance in the chief apple-growing districts; occasionally —as in the past year—it becomes rather more frequent than usual, and it then causes losses in some of the more northern counties, such as Northumberland and Westmorland, with sporadic outbreaks elsewhere.

Although the apple fruit miner has not yet proved of much direct importance to fruit-growers in England and Wales, it is not without some interest since it has, on more than one occasion, led to a scare that some American pest has obtained entry into the country. This is partly because references to the apple fruit miner are not infrequent in North American literature, whereas they are few in English publications; but it is mainly due to the fact that the injury caused by the pest bears a considerable resemblance to that produced by the American apple fruit fly as pictured in American publications. Statements in the Press during the past autumn will have dispelled any fear that the apple fruit miner is a pest of American origin, but the confusion between the apple fruit miner and apple fruit fly is quite justifiable, and since the latter (a scheduled pest under the D.I.P. Acts) is one which should be kept out of Britain as long as possible, a few notes on the two may be welcome.

The Apple Fruit Miner has not been studied in great detail in Britain, but its habits are more or less as follows: The adult moths—one of which is shown in Fig. 1—come out in June and July; eggs are laid on the young apples (according to Continental authorities, near the eye), also on crab apples and the berries of mountain ash, and on hatching give rise to

* *Argyresthia conjugella*, Zeller. † *Rhagoletis pomonella*, Walsh.

caterpillars, which bore into the flesh of the fruit. The burrows so caused are usually very winding and twisted, and at first lie not very far beneath the skin of the apple. The affected areas usually show from outside the fruit owing to a shrinking-in of the skin, which darkens in colour (Fig. 4). There is often also a very minute hole somewhere in this shrunken area which is where the young caterpillar originally ate its way in.

As the caterpillars grow they penetrate further into the flesh and may reach the core or burrow through the seeds (Fig. 5). When full-fed, usually in September or October, the caterpillars (Fig. 2)—which are pinkish-white in colour with a brown head—burrow out through a hole in the side of the fruit, leaving no signs of excrement in the hole, and crawl to a position under the loose bark, or perhaps in rubbish round the foot of the tree, where they spin a white silken cocoon (Fig. 3) in which the winter, spring, and early summer is spent. There is no definite evidence of more than one brood, though. during 1925, some of the caterpillars did not leave the fruit until well into November, an occurrence which suggests the possibilities of a second brood of moths in September, though this is considered improbable.

The Apple Fruit Fly has somewhat similar habits to those of the moth. The adults are small brightly coloured flies with striped wings (Fig. 6). They emerge in Canada in July and live until the middle of August or later. The female flies are equipped with a special apparatus like a sting, which enables them to place their eggs under the skin of the fruit. From the eggs are hatched white maggots, blunt at the hind end and pointed in front, but without any obvious head (Fig. 7). These maggots burrow in the flesh of the apple, but they cannot grow rapidly until the fruit is ripening, so that in the early varieties, which the fly prefers, the maggots become full fed much more rapidly than in the case of later varieties. When full fed the maggots leave the fruit, and burrow into the soil, where they pupate and remain until the following year before giving rise to adult flies. No examples of the fly or its maggot have yet been found in Great Britain, neither have infested apples been detected among Canadian or other American fruit.

Comparison between the Apple Fruit Miner and the Apple Fruit Fly.—The adult insects are totally different, but neither

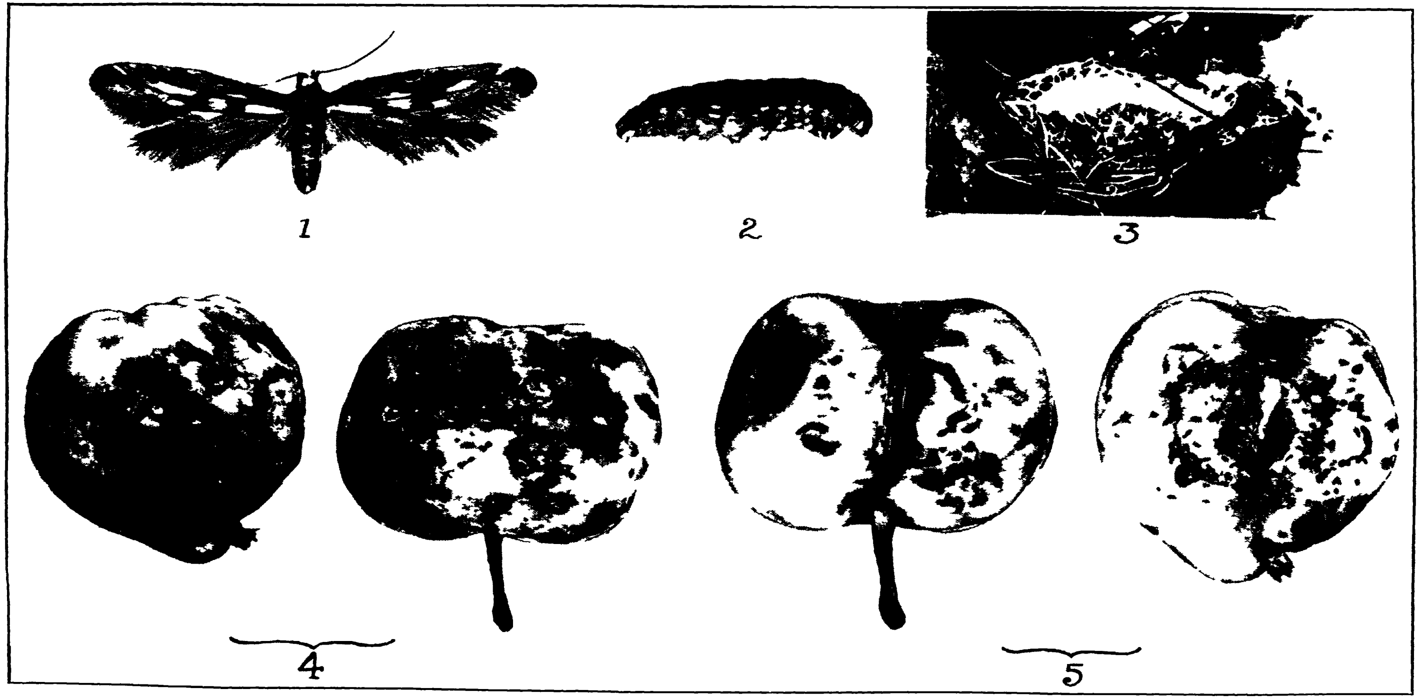

FIG 1 —Apple Fruit Miner (female) FIG 2 —Caterpillar of Apple Fruit Miner FIG 3 —Cocoon of Apple Fruit Miner in Crevice in Bark
FIGS 4 and 5 —Apples injured by the Apple Fruit Miner (exterior and interior, the latter showing the maggot)

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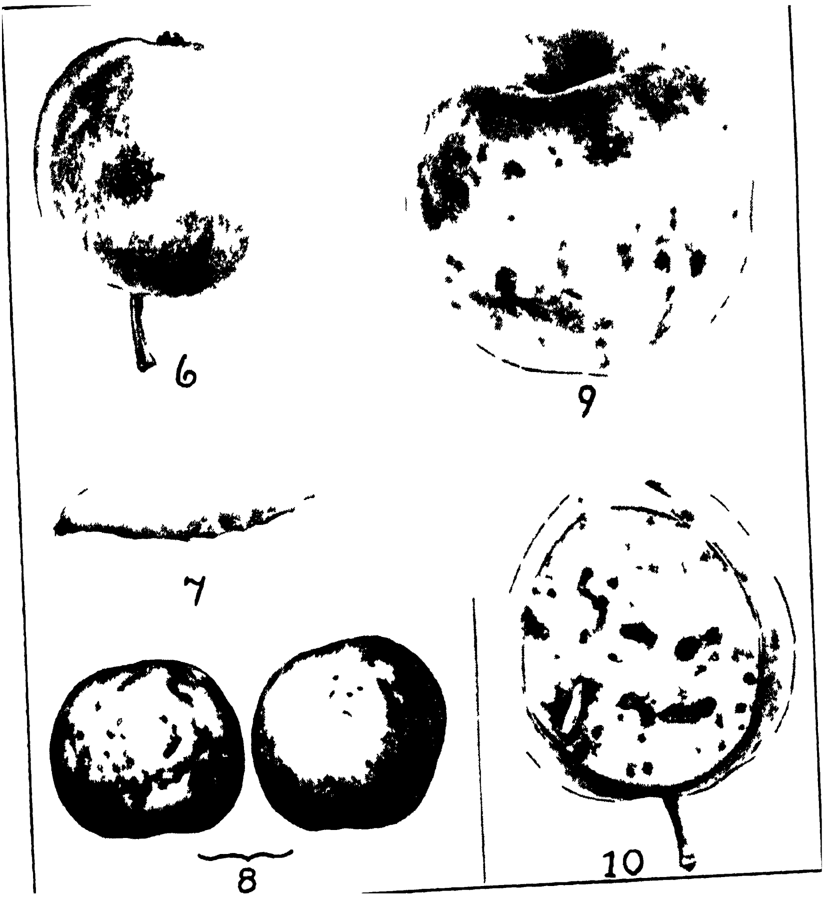

Fig. 6. Apple Fruit Fly upon an Apple
7. Maggot of Apple Fruit Fly
8. Apples showing Egg Punctures
9. Apple injured by the Fruit Fly
10. Interior of Apple injured by the Fruit Fly, showing Maggot

are readily seen. It is therefore in the damaged fruit and the larvæ that resemblances and distinctions must be sought. In the first place, Figs. 4 and 5 representing the work of the fruit miner (taken from Scottish specimens), and Figs. 9 and 10 of Canadian apples attacked by the fruit fly, show that, in pictures at all events, the damage is very similar. The following would seem to be the chief distinctions. In the first place, the fruit fly, in depositing her eggs, causes little pits in the skin (Fig. 8) which the miner does not. Next the burrows of the fruit fly are larger and there are not the number of minute burrows crowded together as in the fruit miner. Finally, and most important, in the case of the apple fruit fly the insect which does the damage is a typical fly maggot without legs or any conspicuous head (Fig. 7), while in the case of the miner it is a small but quite obvious caterpillar with the usual legs and a brown head (Fig. 2). In cases of doubt the last distinction is perhaps the best—is the insect inside the fruit a caterpillar or a white maggot ? If the former, no special alarm need be felt, but if the latter, it is very important that specimens should be examined by an expert to make certain whether it is really a fruit fly maggot or the maggot of some harmless fly which has chanced to get into a damaged apple.

Methods of Control.—It is so seldom necessary to control the fruit miner that no experiments seem to have been carried out in England. It is not desirable to spray apples in July or August with an arsenical wash, and this type of spraying is therefore ruled out. It may be mentioned that in the writer's experience the caterpillars prefer to make their cocoons under loose bark, and it is very probable that winter spraying would, if necessary, keep the insect in check, while in small gardens the same end might be met by sack-banding as for codling moth.

As regards the apple fruit fly, the one satisfactory method is that which in a previous paragraph it has been suggested should be ruled out, *viz.*, late spraying with an arsenical insecticide. It has been found that the flies will readily eat lead arsenate both on foliage and fruit, and the Canadian recommendation is that two sprayings should be given, the first at the end of June and a second about three weeks later, followed by a third if the second spray is washed off by rain, Prof. Cæsar writes that this treatment will practically eliminate the fly from an orchard in two years. It is well to know that

a remedy does exist, but from the English point of view it is an unsatisfactory one, and clearly the only conclusion to be drawn is that the American apple fruit fly is one which should be kept from English orchards for as long as it is possible to do so. To this end it is desirable that all who grow or handle apples, whether produced at home or abroad, should know what to look for, and even if such vigilance results in an occasional unwarranted scare, no great harm is done, especially as compared with the evil results which might follow an undetected outbreak.

Sincere thanks are due to Prof. Cæsar, of the Ontario Department of Agriculture, for his kindness in supplying the prints from which Figs. 6, 7, 8, 9, and 10 have been prepared, and readers anxious to obtain further information as to the apple fruit fly may be referred to Bulletin 271 of the Ontario Department of Agriculture, by Cæsar and Ross, which contains a very complete account of this pest and the methods of dealing with it in Canada.

NOTE.—Since the above article was written, a full account of the apple miner, by Dr. McDougall, has appeared in the *Scottish Journal of Agriculture* (Vol. IX, No. 1, January, 1926), to which readers who wish to know more about the outbreak of this pest in Scotland in 1925 are referred.

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THE MANURING OF TOMATOES

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MANY glasshouses in South Lincolnshire, used, primarily, for the chitting or sprouting of potatoes, are devoted during the summer months to the production of tomatoes. While tomato growing cannot be said to occupy any large share in the activities of local agriculturists it is, nevertheless, a profitable sideline. As many growers appear to possess little definite information concerning the manurial requirements of this crop, the writer decided in April, 1925, to carry out a few simple experiments designed to demonstrate some of the more important results obtained in recent years at the Cheshunt Experimental Station. Some twelve years' work at this latter centre has revealed the importance of manuring as a preventive of disease, and as an aid to the production of increased yields of high-grade fruit. Some of the first of the Cheshunt experiments were designed to test the efficiency of the mixtures commonly employed by growers in that district. These mixtures were largely organic in character,

consisting of dung, steamed bone flour, bone meal, ground hoofs and horns, and sulphate of potash ; on trial they proved inferior to mixtures of artificial manures, which supplied equivalent quantities of nitrogen, phosphates, and potash. In view of the esteem in which organic manures are still held by many local growers, it was considered worth while to lay down a somewhat similar experiment. The objects of the experiment may be summarised as follows :—

(1) To test the efficiency of a complete mixture of artificial manures against a mixture of organic manures providing equivalent amounts of plant food.

(2) To determine the relative values of different nitrogenous organic manures.

(3) To compare superphosphate against other sources of phosphate.

(4) To test the value of top-dressing.

A small "chitting house" of the usual type was laid out in plots, each having an area of four square yards, running at right angles to the length of the house, and intersected by a central path. The sides of the house faced north and south, so that all plots received a like share of sunshine. Before planting, the ground was thoroughly worked, additional soil to a depth of six inches was carted in, and an adequate dressing of ground limestone was applied to the whole. Each plot carried twenty-four plants, which were trained on strings secured below to stout pegs and above to overhead wires. Every effort was made to maintain an equable temperature during the growing period, thermometer readings being taken at regular intervals during the day. A certain number of plants were attacked by wilt (*Verticillium Albo-atrum*), and in these circumstances it was found necessary to record the yield of each single plant. All fruit was graded according to size and quality ; a considerable weight of tomatoes which remained green when the experiment was concluded was recorded under the third grade. The variety gown was Kondine Red, and the young plants, when obtained in the early part of May, were in a backward condition, a fact which probably accounts for the relatively low average yield per plant.

Artificial Manure Mixtures.—The complete mixture of artificials, referred to in this article as "Standard Artificial Mixture," contained superphosphate, sulphate of ammonia, and sulphate of potash, and was made up to show the following analysis :—

Ammonia	5·0 per cent.
Potash	12·5 ,,
Total phosphates	17·6 ,,

This mixture, which is similar in composition to the Cheshunt Growers' Standard, except that it contains somewhat less phosphoric acid, was applied at the rate of 2 lb. per square yard. All the other mixtures employed, with the exception of one, were so compounded that 2 lb. supplied plant food equal to that contained in a similar weight of the Standard Artificial Mixture. The complete mixture of organic manures, referred to as "Standard Organic Mixture," contained dried blood, Peruvian guano, steamed bone flour, and sulphate of potash, together with some clean sand, the latter being included as a filler. The exact composition of the individual ingredients was determined in the laboratory. A list of the different mixtures employed is given below :—

STANDARD ARTIFICIAL MIXTURE
20 lb. Sulphate of ammonia
25 lb. Sulphate of potash
55 lb. Superphosphate
At 2 lb. per square yard.

STANDARD ARTIFICIAL MIXTURE LESS NITROGEN
25 lb. Sulphate of potash
55 lb. Superphosphate
20 lb. Sand
At 2 lb. per square yard.

STANDARD ORGANIC MIXTURE
20 lb. Steamed bone flour
21·1 lb. Peruvian guano
13 lb. Dried blood
25 lb. Sulphate of potash
20·9 lb. Sand
At 2 lb. per square yard.

MIXTURE 1
25 lb. Sulphate of potash
33·9 lb. Dried blood
52·7 lb. Superphosphate
At 2¼ lb. per square yard.

MIXTURE 2
25 lb. Sulphate of potash
37·9 lb. Peruvian guano
26·4 lb. Superphosphate
10·7 lb. Sand
At 2 lb. per square yard.

MIXTURE 3
25 lb. Sulphate of potash
51·5 lb. Fish meal
22·8 lb. Superphosphate
·7 lb. Sand
At 2 lb. per square yard.

MIXTURE 4
25 lb. Sulphate of potash
18·2 lb. Sulphate of ammonia
29·3 lb. Steamed bone flour
27·5 lb. Sand
At 2 lb. per square yard.

MIXTURE 5

20 lb. Sulphate of ammonia

80 lb. Sand

At 2 lb. per square yard

The following dressings were applied to the different plots:—

Plot 1.—Base dressing of 2 lb. standard artificial mixture per square yard.

Plot 2.—Base dressing of 2 lb. standard organic mixture per square yard.

Plot 3.—Base dressing of 2¼ lb. mixture 1 per square yard.

Plot 4.—Base dressing of 2 lb. mixture 2 per square yard.

Plot 5.—Base dressing of 2 lb. mixture 3 per square yard.

Plot 6.—Base dressing of 2 lb. mixture 4 per square yard.

Plot 7.—Base dressing of 1 lb. standard artificial mixture per square yard.
Two top dressings of ½ lb. each standard artificial mixture per square yard.

Plot 8.—Base dressing of 2 lb. standard artificial mixture less nitrogen per square yard.
Two top dressings of 1 lb. each mixture 5 per square yard.

The experiment was purely qualitative in character, all plots receiving exactly the same weights of nitrogen, phosphates, and potash. The results are shown in the following table :—

Plot	Yield per plot in lb.	Average yield per plant in lb.	First grade fruit per cent.	Second grade fruit per cent.	Third grade fruit per cent.
1	65·8	3·29	48·9	21·0	30·1
2	89·8	4·49	66·9	12·8	20·3
3	86·7	4·33	68·1	12·0	19·9
4	77·4	3·87	62·7	18·8	18·5
5	80·6	4·03	62·5	18·9	18·6
6	76·9	3·84	60·3	16·5	23·2
7	76·0	3·80	62·3	17·0	20·7
8	77·2	3·86	52·8	21·7	25·5

These figures would appear to indicate that, under the conditions of this experiment, organic manures should be preferred to artificials on tomatoes. The superiority of Plot 2 over Plot 1 is marked ; not only has the former yielded over 1 lb. per plant more, but the percentage of first-grade fruit is appreciably higher. Organic manures have further proved their usefulness in Plots 3, 4, 5, and 6. Of the three organic nitrogenous manures used, dried blood has proved most effective, and Plot 3 has produced a higher proportion of first-grade fruit than any other, and a yield inferior only to Plot 2. Plots 4 and 5, which received their nitrogen as Peruvian guano and fish meal respectively, also show a larger proportion

of best-quality produce than any plot which received a wholly artificial mixture. From a comparison of the results obtained on Plots 1 and 6, it will be seen that superphosphate has given neither the yield nor the quality produced by steamed bone flour.

Top-dressing has proved beneficial on both Plot 7 and Plot 8. The latter, on which only the nitrogenous portion of the mixture was applied as a top-dressing, has yielded slightly better than the former, which received only one-half of the complete mixture before planting, and was top-dressed with the remainder. It is, however, worthy of notice that Plot 8 has failed in the production of high-quality fruit.

It is not suggested that any hard and fast conclusion can be drawn from these simple experiments; the fact that they have only been carried out during one season, and the small scale upon which they were conducted, will not permit of it. At the same time, it should be pointed out that under the conditions of such an experiment as this, there must be a much less serious error due to seasonal variation than in the case of an ordinary field experiment. Further, the fact that mould is carted into the house should reduce soil variation to a minimum, and obviate the necessity of replication. While the results have failed, in some particulars, to ratify those obtained at Cheshunt, it was felt that they might prove of interest, not only to local agriculturists, but to potato growers in other districts who desire to put their "chitting" houses to some profitable use during the summer months.

COUNCIL OF AGRICULTURE FOR ENGLAND

THE twenty-first meeting of the Council was held on June 1, 1926, at the Middlesex Guildhall, Westminster, Lord Clinton, the chairman for the year, presiding. The chairman said that before commencing business he would like to return thanks to the Council for the honour they had conferred upon him in appointing him chairman for the year. He had had the advantage with many others of being a member of the Council since its beginning, and he had watched its development with great interest. At the commencement, the Council was a body whose proceedings were largely unorganised, being dependent for business upon the chance proposals of in-

dividual members, but in the last year or two that position had been superseded by the admirable work of the Standing Committee. The Council also had the advantage, shared by no other body, of the presence of the Minister and the Parliamentary Secretary at its meetings, so that it was able to keep in very close touch with Government intentions in regard to the Industry. The Agricultural Policy which the Council put forward last year had in the main found acceptance with the Government, and Lord Clinton expressed the hope on behalf of the Council that the Council would have a further opportunity of dealing with details before the proposals took legislative form.

Statement by the Minister of Agriculture.—The Rt. Hon. Walter Guinness, M.P., Minister of Agriculture, said that at the last two meetings of the Council he had dealt in some detail with items of agricultural policy. To-day there were no new developments of policy, and the Ministry was engaged in working out details with a view to legislation. In regard to foot-and-mouth disease, Mr. Guinness said that in March and April there had been some serious outbreaks in East Yorkshire. It was a district where large numbers of cattle and sheep were wintered, and the position became very serious owing to lack of feed. The hardship on the farmers was very great because a lot of the stock was ready for market, and, under the necessary restrictions which had to be imposed, large losses were inevitable. He was glad to say that the local farmers "played up" in a very efficient way, and with the assistance of the National Farmers' Union they had set up a temporary co-operative abattoir which enabled them largely to minimise their losses. The number of outbreaks in the last month—May—was eighteen; in April it was ten; in March it was nineteen.

In the last ten days there had been a new and unfortunate development. Scotland, which had been free from foot-and-mouth disease for over two years, had now become a centre of a new outbreak, and in connection with this outbreak a very important discovery had been made, *viz.*, that the origin of the outbreak was the foreign pigs brought in for curing at a British bacon factory. There have been seven outbreaks in the vicinity of the bacon factory at Carluke, and they were all traced to infected carcasses brought in from Holland and Belgium. The infected carcasses came from Belgium, but they came through Rotter-

dam. Apart from the carcasses at Carluke, there was now another case of foreign infection through Carlisle, and a shipload including infected carcasses had arrived at Leith. The Ministry had long suspected that foot-and-mouth disease might be brought to this country by foreign meat, and especially offals—which obviously were an extremely dangerous source of infection, being full of blood, the most dangerous medium for carrying disease of this kind. For the first time, the Ministry had got absolutely definite and complete evidence, and now that they had been able to get on to it—because it must be remembered that there was no machinery in the ordinary course under the Ministry for inspecting meat cargoes at the port—and traced it back from the outbreak, it was absolutely imperative that action should be taken to minimise the risk. At the same time, he was sure that the Council would understand that this matter raised issues of great importance, and he could not give any indication of what action he would take until he had consulted the Government as a whole. He assured the Council that no time would be lost.

He referred then to the discussion at the last meeting as to the arrangements for the double-dipping of sheep. Since that meeting, it had become evident that there was so much difficulty in Scotland that it would not be possible to enforce a national Double-dipping Order during the present summer. An Order had, however, been issued prohibiting the use of arsenical dips for the second dipping in the present year.

The arrangements for Empire and British marketing of agricultural produce had been advanced, and representation had been obtained for agriculture on two bodies which had been set up to deal with the matter. Final decisions would be taken by an Imperial Marketing Board, of which the Secretary of State for the Dominions was the Chairman, and on which Lord Bledisloe was Agricultural Representative. Mr. F. N. Blundell, M.P., was the representative on the Imperial Economic Committee.

The Minister then referred to the position in regard to this year's crops and prospects. The general index figure for prices had continued to decline since the beginning of the year, and at the end of April was 53 per cent. above pre-war. Costs had also declined, and feeding stuffs, seeds and fertilisers were all relatively down on the prices of produce. Wages were, of course, an important exception, being 75 per cent. above pre-war rates, although the cost of living was

only 67 per cent. above. He realised the great difficulties which this heavy burden had thrown upon the farmer, but he thought it was generally recognised that pre-war wages gave too low a standard of existence to the agricultural worker. He was far from suggesting that an uneconomic wage could be justified or that it would do other than harm to the industry. At the same time, good work could not be got from labour which was not paid a reasonable remuneration. So far, the industry had been free from trade disputes. At the last meeting, trouble was certainly threatened in Norfolk, but he was glad to say that both sides had showed a spirit of compromise and a settlement had been arrived at without any stoppage. It was satisfactory, also, that in the last few weeks, when the country had been through the ordeal of a general strike, agriculture should have escaped that new and serious development. The industry carried on as usual, and he hoped that it would thereby reap a reward in escaping the most serious consequences which the strike had brought to other industries and from which they must continue to suffer for a long time to come.

General CLIFTON BROWN, M.P. (West Sussex), referring to the Minister's statement that foot-and-mouth disease had been imported from abroad, said that the Council ought to press upon the Minister, and through him the Government, the great urgency of the matter: and that there should be power in the Ministry to inspect shipments of meat from abroad. He had heard that there was an outbreak of foot-and-mouth disease in the Isle of Wight, and he asked for information concerning it. The MINISTER replied that an embargo had been put on the landing of any of the cargo of the ship in Leith and it had been sent back to the port of origin. The Ministry had no machinery for inspecting meat; that duty fell upon the Ministry of Health: but as soon as the evidence had been completed, warning was sent to the Ministry of Health, who were watching the matter very closely pending the decision of the Government as to what steps were to be taken effectively to deal with the matter. The origin of the outbreak of foot-and-mouth disease in the Isle of Wight was quite obscure. There had been no fresh developments since the disease had originally showed itself there, and the area had been reduced as from to-day.

The Rt. Hon. F. D. ACLAND asked if there was reason to suspect the general importation of meat into this country, beef and mutton, or whether the infection referred to by the

Minister was confined to pig carcasses brought into the country for the purposes of turning into bacon. The MINISTER replied that he did not think it was possible to distinguish between pork which came in to be consumed as such and pig meat which came in to be cured in a British bacon factory. The conditions of export from the Continent were exactly the same in each case, and although there was no evidence as to the danger of infection to livestock from meat which was consumed as pork, there was no reason to think that there was any difference between one type of pig meat and the other. The importation of beef and mutton from the Continent was insignificant, and the Ministry had no evidence one way or the other about any danger from that source; but as the conditions of inspection abroad were the same for all classes of meat, and for the livestock from which they came, any steps that were taken must deal with the whole question of freshly-killed foreign meat.

Mr. H. C. GARDNER (Worcester) said that he viewed with some alarm the total prohibition of arsenical dipping next year as foreshadowed by the Minister, and he hoped further consideration would be given to that matter because it was the opinion of some that arsenical dipping was much more effective as regards the fly than other dips. The MINISTER replied that he referred only to the statutory dipping against scab. For fly and other purposes there would be no interference whatever with the freedom of the farmer to use what dips he liked.

Mr. J. S. GIBBONS (Gloucester) asked if the Ministry of Agriculture had considered at all whether there was any danger of foot-and-mouth disease from the importation of beef from the Argentine. The MINISTER replied that Sir Stewart Stockman had been to the Argentine recently and had inspected the arrangements there, and had made a very full and interesting report. The Ministry had no evidence whatever against the frozen meat trade. The conditions in the frozen meat trade were entirely different from those in the fresh meat trade which had caused these recent outbreaks. The frozen meat trade was also free from the very dangerous business in offals which was perhaps the most urgent problem in the case of the trade with Europe. Sir Stewart Stockman had inspected the method by which hides, pelts and hoofs were dealt with in the Argentine, and had found that they were absolutely sterilized, not with the intention of dealing with foot-and-mouth disease at all, but

owing to the conditions of the trade. It would be very unfortunate if any impression were given that the evidence which the Ministry had got in the case of the imports of fresh meat from Europe bore in any way upon the importation of frozen meat.

Mr. R. BRUFORD (Somerset), referring to the question of labour, did not think it should go out to the public that the cost of labour to the farmer was only 75 per cent. above pre-war, because the men now had a shorter day, and although they had still many good agricultural labourers he was sorry to have to say that there were others who did not take that same interest in their work and give as good service as they used to do.

The MINISTER, replying to a question by Mr. PATTERSON (Staffs), said that in all cases where foot-and-mouth disease had been discovered in carcasses it was only in those of pigs and not in beef or mutton.

Major R. B. TURTON (Yorks, North Riding) asked if the Council were to understand from the Minister's statement that there was to be no Double-dipping Order made this year. The North Riding had made their Double-dipping Order enforcing the old dippings in the old periods, and they hoped that would be confirmed. The MINISTER replied that Local Authorities would continue to be free to make their own orders and their own local restrictions on movements from outside.

Wool Marketing in England and Wales.—Mr. ACLAND, Chairman of the Standing Committee of the Council, moved the adoption of the Report from the Standing Committee on the subject of the Ministry's Report on Wool Marketing in England and Wales. The main object of the Standing Committee's Report was to bring before the Council the Ministry's Report which dealt comprehensively with the subject from the producer's point of view for the first time on record. It appeared from it, that progress could best be made along the lines of better breeding of sheep for wool as well as for mutton, of improved preparation of wool for market, by improved handling, better cleaning, grading and packing, and by better marketing. Mr. Acland said that the Report was very practical and informative, and pointed out what no one could deny, which was the importance of organising sales and the business preceding sales. The Kent Wool Growers, in the starting of which he had something to do, had been

the first Association to put properly-graded wool on the London wool market. He referred to the proposal to set up a Wool Breeding Council for Great Britain to assist the much-needed improvement in wool by experimental work and otherwise. The Report was received by the Council.

The War Office Light Horse Breeding Scheme.—Capt. E. T. MORRIS (Herts) moved the adoption of the Standing Committee's Report on the Light Horse Breeding Scheme. The Report stated that the Committee had had a conference with General White, Director of Remounts, from which it appeared that the Light Horse Breeding Scheme, which had been in operation under the War Office for two years or more in the form in which it had previously operated under the Ministry of Agriculture, ought to be better known amongst farmers. To effect this, the War Office was prepared to encourage the holding of suitable agricultural shows of exhibition classes of (*a*) the types of horse required for army purposes, and (*b*) the types of half-legged brood mares suitable for breeding. The War Office was also prepared to license out or sell cast mares of a suitable type to farmers for breeding, though the supply of them for the present was likely to be rather small. The War Office was also prepared to consider whether young horses could not be purchased at three years old instead of four (the age they were required for army purposes) and left in the custody of the farmer for the remaining year at a suitable fee, though it was thought that such horses could at first only be bought in small numbers as an experimental measure.

The Committee considered that the authorities of agricultural shows should be invited to afford facilities for the holding of the exhibition classes mentioned above, and that the livestock officers in the various provinces might assist the Light Horse Breeding Scheme in any way they could, especially by bringing to the notice of the County Committee pamphlets and photographs, which the Director of Remounts informed the Committee were in existence. The Committee was also of opinion that if the War Office was authorised to offer a sufficient price for horses direct to the breeders, the proposals or suggestions made above would be likely to have some effect in encouraging farmers to breed the type of horse required. Capt. MORRIS, in commending the Report, said that breeding horses for the War Office was a very risky

business. He was not sure about the cast mares. As a rule they were not fit to breed from, or to work.

Lord BLEDISLOE, Parliamentary Secretary to the Ministry, said that he was not in agreement with that part of the Report suggesting that the Ministry's Livestock Officers might take a part in the Scheme. These officers had their hands exceedingly full, and they were, moreover, not qualified for the work in connection with light horse breeding. Mr. GUY FENWICK (Rutland) said that the demand for the services of thoroughbred stallions had increased enormously in Rutland and Leicestershire. The Director of Remounts had done a great deal to assist farmers with the marketing of half-bred horses, and if the War Office could see its way to purchase three-year-old horses as suggested in the Report it would further help the scheme. Mr. J. HAMILTON (Lancs) suggested that the opinion of the County Livestock Committees would be of use in regard to the type of horse suitable for a particular district. Mr. R. L. WALKER (Yorks W.R.) thought that the supply of light horses in the West Riding was at present greater than the demand. General CLIFTON BROWN (West Sussex) welcomed the Report. He considered that the type of horse used by the army to-day was slightly better bred than formerly, though smaller and lighter. Farmers could breed these horses if they knew what the type was, and were paid sufficiently for it. The cast mares would not be of much use to the farmer. Mr. G. G. REA (Northumberland) considered that the breeding for the War Office was a most unremunerative proposition, because the War Office really wanted misfits and, at present, provided no real inducement to farmers to breed horses. In the North, many young horses had been bred, but very few taken by the War Office, with the result that owners had become discouraged. He thought that the War Office should buy good-class animals at three years old and take them to depots where they could be broken in and put into service when they were four years old. Some might develop into better animals than were required by the army, and those could be sold at good prices as hunters. In that way, the country would have a considerable nucleus of horses to meet the demands of the army in times of emergency. Mr. DENT BROCKLEHURST (Gloucester) asked whether the War Office had any difficulty in getting the horses they required. Lord BLEDISLOE replied that there was reason to think that the army at present was not seriously short of horses for peace-time requirements, but it had to be

remembered that the War Office had to make plans for all possible emergencies. In 1914, the War Office had been very short of certain types of horses, and it was now evident that the department was anxious to obtain more horses of the right type. The Report was then received.

Credit for Farmers.—Mr. ACLAND, on behalf of the Standing Committee, moved the following resolution :—

> That the Council of Agriculture for England welcomes the proposals which it understands are still under the consideration of His Majesty's Government for the provision of facilities for agricultural credit on the lines of the Ministry's Report, Economics Series No. 8. In the view of the Council, and as stated in their Report on Agricultural Policy dated August 6, 1925, the provision of credit is of the utmost importance to Agriculture, and the Council hopes that a scheme providing some real asistance to the industry will be worked out and presented at an early date.

Mr. DENTON WOODHEAD seconded the resolution. The MINISTER replied that he welcomed the spirit in which this resolution was brought forward. The Government was glad to have the support of the Council of Agriculture in this matter, which was valuable in showing the feeling in the industry that further credit arrangements were imperative. He could not say anything new on the subject to-day, and he hoped that the difficulties which were being met with the banks and other interests would be surmounted. The matter was not altogether easy, and he did not think that a wise and permanent solution would be helped by any premature decision or any attempt to rush legislation on so very difficult a question. The resolution was then put to the meeting and carried.

Pooling of Surpluses, National Health Insurance.—Mr. DENTON WOODHEAD moved the following resolution on behalf of the Standing Committee :—

> That the Council of Agriculture for England protests in the strongest manner against the recommendation of the Royal Commission on National Health Insurance that in future half the surplus funds of Societies should be pooled. In the view of the Council, the contributions now required from Agriculture are excessive because of the comparatively good general health of those employed in the industry. The pooling of surpluses therefore would amount to a tax on the industry for the benefit of other industries, which, in the opinion of the Council, is not justifiable. The Council desires to bring this matter at once to the attention of the Government, and to express the earnest hope that, in preparing legislation, the Government will see its way to give effect to the Council's view.

Mr. WOODHEAD recalled to the Council that the Standing Committee had been asked to put the Council's views on this subject before the Royal Commission on National Health Insurance. He pointed out that as far back as 1911 agriculturists had claimed special treatment in National Health Insurance on the ground that agricultural workers were a more healthy class than most other industrial classes in the country. The claim was at that time based on theory, and it had been met by the statement that if the theory was correct any surplus fund would belong to agricultural workers. The theory had been proved correct. Individual members of the Council should begin opposing the proposal of the Royal Commission to pool all surpluses at once. It was not known whether legislation would be formulated on the Report, but, if it were, it was no use waiting till the Bill was produced and then trying to get the Government to alter it. County Agricultural Committees should take the matter in hand and also the Agricultural Committee of the House of Commons. The motion was seconded by Capt. E. T. MORRIS, who pointed out that if 50 per cent. of the surplus funds were to be pooled it would mean asking the lowest-waged earner to subscribe to the sickness of a man earning 100 per cent. more than he earned, a proposal most unfair to agricultural workers. It was said that the 50 per cent. was only the employer's contribution, but what was the employer's contribution? It was one which the employee had to earn before it could be paid, and therefore it belonged to the employee.

The MINISTER said that the resolution was in good time because no decision by the Government on the Royal Commission's Report had yet been made. He was quite certain that the evidence put forward on behalf of the Council would be fully considered by the Ministry of Health. Col. Sir GEORGE COURTHOPE, M.P. (East Sussex), assured the Council that the matter would be brought before the Agricultural Committee of the House of Commons without undue delay. Alderman DAVIS (Durham) said that as far as the miners were concerned they were not particularly anxious to get any of the 50 per cent.; they would wait till they got nationalisation all round and then they would secure the whole. The resolution was put to the meeting and carried.

Building Subsidy for Rural Areas.—Mr. ACLAND, on behalf of the Standing Committee, moved the following resolution:—

That the Council of Agriculture for England views with alarm the possibility of the existing subsidy on the building of cottages

in rural areas being withdrawn before the shortage in proper housing accommodation for agricultural workers has been adequately met, and would strongly urge the Government to delay the consideration of any such proposal.

Mr. Acland said that the mere suggestion that it might be possible to diminish or to withdraw the present subsidy given by the nation towards housing had struck all who were keen on the improvement of conditions in rural districts with dismay. He did not consider the suggestion to be one at all likely to be acted on, but it was important that the Council should affirm the need for the continuance of the subsidy. As regards country parishes, there was a higher subsidy under the Wheatley Act than for urban parishes, but he could not get separate figures for the two groups: 99,000 houses in all had been approved under this Act, 39,000 were under construction and 33,000 had been completed.

Nothing should be done to discourage, but rather everything should be done to encourage, our Rural District Councils to proceed with housing schemes. These Councils would realise more and more as they went into matters that better housing would actually pay them. The cost of maintenace of mental defectives in Devonshire had risen in four years from about £8,000 to £16,000. The contribution to this cost from the County rates was something like 1d. in the £. Half of the expenditure was avoidable under better housing conditions. If one went through the estimates of other County Committees dealing with tuberculosis, child welfare, and different health services falling both on County rates and on district rates, it would be found that a large margin of the rates could be got rid of through better housing. Many rural districts had not even rated themselves up to a 1d. rate to improve their housing. If they could spend a 2d. rate they should save a 3d. or a 4d. rate on other services. Mr. DENTON WOODHEAD seconded the resolution, and Lord BLEDISLOE, on behalf of the Ministry, pointed out that, so far as the Ministry was concerned, Mr. Acland was pushing an open door. It was quite true that the Ministry of Health was required to review the position with regard to the Housing Subsidy every other year. The first revision would, in the ordinary course, take place on October 1 next. No change could be introduced until the House of Commons had decided that it should be so, and he thought that the Council could leave the matter in the hands of those who represented the agricultural industry in the House of Commons. The Ministry had no present knowledge,

or indeed any indication, that the present subsidy on cottage building was likely to be withdrawn. Separate figures for rural and urban housing, respectively, could, he thought, be obtained, and they would be furnished at the next meeting of the Council unless in the meantime they were given an answer to a question in the House of Commons. The resolution was put to the meeting and carried.

Foreign and Colonial Restrictions on British Pedigree Live-stock.—Col. Sir GEORGE COURTHOPE, M.P. (East Sussex), moved the following resolution :—

> That in the opinion of the Council of Agriculture for England, the Regulations for the Importation of Pedigree Live Stock enforced by the Dominion of Canada, the Irish Free State, and the United States of America act as an absolute embargo on the shipping of Live Stock to those countries, and appear to be unjust to British Breeders. The Council, therefore, requests the Minister of Agriculture to endeavour to obtain such modification of the regulations now in force so that Pedigree Live Stock may be admitted to all the British Dominions, the Irish Free State, and the U.S.A. from any county in Great Britain which is free from foot-and-mouth disease.

He said that he realised that it might be difficult for the Ministry to take the line suggested in the resolution under present circumstances. At the same time, the export market for high-grade pedigree stock had disappeared. On the other hand, Canadian and Irish stores circulated freely in this country. The resolution had first been put forward by the Breed Societies, who were anxious that the Ministry should secure such modification of the regulations as was possible. There was no reason why the export of Sussex stock should be stopped because foot-and-mouth disease was found in Dutch carcasses in Scotland. Mr. J. EVENS seconded the resolution and said that he had been asked to do so by the National Cattle Breeders' Association. Lord BLEDISLOE, on behalf of the Ministry, said that he was entirely in sympathy with the views put forward, though it was peculiarly difficult to take action at the present moment. Since January 1, there had been no fewer than eighty-four outbreaks in nineteen different counties in Great Britain, and the Ministry could not make out a satisfactory case to the Dominions to relax their precautionary measures against foot-and-mouth disease in regard to British pedigree stock. The Argentine Government did allow a difference to be made between one part of Great Britain and another. Indeed, if a County had been free for 3½ months, pedigree animals could be exported from

it to the Argentine. It must be remembered, however, that the position of Argentina with disease was different from that of Canada and the United States without it. We could not ask the latter countries to take animals from this country when we would not admit theirs if foot-and-mouth disease were prevalent with them. The Breed Societies might, however, possibly usefully approach the Dominions and the other countries direct with a view to preparing the ground for the admission of stock on the lines indicated in the resolution. Mr. MATTHEWS (Hereford) supported the resolution. Mr. PATTERSON (Staffs) opposed it, on the ground which Lord Bledisloe had indicated.

Sir GEORGE COURTHOPE then suggested an amendment of his resolution to leave out the last sentence. The resolution as amended was carried.

Economy Bill Proposal.—Mr. DENTON WOODHEAD moved the following resolution :—

> That the Council of Agriculture for England protests most strongly against the action of the Government in proposing to deprive Approved Societies under the National Health Insurance Act of £2,800,000 per annum, being Government Grant, as it will seriously cripple the operation of assisting insured persons by means of additional benefits.

It was seconded by Mr. HAMILTON, and discussed by the Minister, Sir Douglas Newton and Capt. Morris, who opposed it on the ground that the question was outside the Council's province, put to the meeting, and lost.

Report from Agricultural Advisory Committee.—The Report (No. 14) of the Proceedings of the Agricultural Advisory Committee for England and Wales was received by the Council on the motion of Mr. GEORGE DALLAS. The Report is appended.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES

Report (No. 14) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee.—Since the last Report was prepared there have been three meetings of the Agricultural Advisory Committee, namely, on March 3, April 14, and May 19, the Minister being in the chair on each occasion.

(1) **Licensing of Bulls.**—At the meeting on March 3, the Minister stated that a very satisfactory report had been received from Northern Ireland on the working of the Compulsory Licensing of Bulls scheme in 1925 in that country. In reply to an inquiry, the Minister said that it was intended to proceed with the scheme in this country as soon as farmers' objections became less pronounced and the country more ready to accept the proposal. It was represented that there was disappointment in Scotland through the scheme having been dropped.

(2) **Merchandise Marks Bill.**—An early opportunity was taken of placing the Bill before the Committee, the difference between it and the previous measure being explained. It was explained that, under this Bill, no commodities would be mentioned specifically in the Bill, but a Standing Committee would be set up which should decide what goods should be marked before entry into the country. The Committee agreed that the object in view was likely to be achieved by the present Bill, which, although it might be criticised as being slower in its procedure than the former Bill, was surer of getting the end accomplished.

(3) **Agricultural Credit.**—The Report which had been presented by the Ministry on Agricultural Credit was discussed, and the Committee informed that the proposals in it were being considered between the Government and the banks. A shorter memorandum was promised so soon as the Government had agreed upon a scheme.

(4) **Arsenical Sheep Dips.**—A memorandum by the Ministry was considered, and it was agreed that the Ministry should issue an Order prohibiting, after January 1, 1927, the use of arsenical dips for the second dipping of sheep for Sheep Scab whenever double dipping was required under the Ministry's Orders or Local Authorities' regulations.

(5) **Foot-and-Mouth Disease.**—At the two first meetings, Mr. Jackson (then Deputy Chief Veterinary Officer) reported on the position of the disease as then existing in the country. At the first meeting, he stated that evidence had accumulated that the disease was being spread by railway trucks, which had carried infected cattle, not being

properly disinfected. Railway companies are required to disinfect their trucks by the Animals (Transit and General) Order, and the Ministry had now taken the matter up and was pressing companies for a thorough disinfection of the trucks.

At the second meeting, Mr. Jackson reported an improvement in the general position in regard to the disease. Outbreaks had, however, been serious in the East Riding of Yorks, where 14 had occurred since March 11. Sheep flocks in particular had been affected, and it was probable that the disease had been spread from flock to flock by birds. In one district about 60,000 fat sheep were nearly ready for market when the disease broke out, and the supply of roots for their feeding had been nearly exhausted. The difficulty, therefore, arose of disposing of them in the face of the impossibility of getting them marketed in the ordinary way and passed thence into the usual channels for consumption. In these circumstances, a number of farmers started a co-operative society for the slaughter and marketing of the animals. This excellent lead was followed in other districts by the National Farmers' Union, which assisted the farmers in difficulty in this matter by all means in their power.

(6) **Draft Milk and Dairies Order.**—At its meeting on April 14 the Committee discussed this draft, and decided to set up a Sub-Committee, consisting of Lord Clinton, Sir George Courthope, Mr. Dallas, Mr. Donaldson, and Mr. Strutt, to go into the subject more fully with officials of the Ministry of Health and the Ministry of Agriculture. This was done, the Sub-Committee, under the chairmanship of Lord Clinton, holding three meetings and presenting its report, which was adopted with slight amendments at the meeting of May 19.

(7) **Destruction of Injurious Weeds.**—As a result of the Ministry's examination of the matter, which was referred to in the last Report to the Councils, a memorandum detailing the lines of a proposed amendment of the law was circulated to the Committee. The Committee agreed that the amendment proposed should be made the subject of a Bill. The Minister undertook to proceed with a Bill as soon as the Government's legislative programme permitted. He did not anticipate, however, that this would be during the present year. (May 20, 1926.)

THE WOOLEY SANATORIUM SETTLEMENT SCHEME

J. A. CASEBY,
Ministry of Agriculture and Fisheries.

EXPERIENCE in the treatment of tuberculosis goes to show that most patients derive very considerable benefit from treatment in Sanatoria under strict medical supervision ; also, that the improvement attained in this way is far too often destroyed when a patient returns to ordinary home conditions and an industrial environment. It would seem, therefore, that most success is to be hoped for if patients can be kept under constant medical supervision and hygienic surroundings for prolonged periods.

There are obvious difficulties, connected with accommodation and expense, in achieving this ideal in the ordinary way ; patients, too, would hardly consent to be separated from their relations and friends for an indefinite period. They may, however, be induced to remain in healthy surroundings if they can obtain suitable and remunerative work there.

The Settlement Scheme, established some two and a half years ago at Wooley, near Hexham, in connection with the Sanatorium for tubercular patients, is a definite attempt to solve the problem outlined above. The settlement adjoins the Sanatorium, which occupies a high and exposed site at Wooley, near Hexham.

This experiment in occupational therapy owes its inception to the Honorary Director, Dr. J. B. McDougall, who is the Medical Superintendent of the Sanatorium ; and it is to his enthusiasm and efforts that so many schemes have been started to provide occupation in the Settlement, and these, with the whole-hearted co-operation of the settlers, have developed with great rapidity.

Miscellaneous Occupations.—Printing is one of these schemes, and the department concerned now supports five ex-patients. It publishes a monthly magazine, which has attained a circulation of over 3,900 copies and forms a bond between patients and ex-patients of the Sanatorium ; and it also executes outside orders for general printing work, such as bills, tickets, printed notepaper, and other stationery. A sign-writing department, started recently, produces window tickets, calendars, hand-painted Christmas cards and similar articles. It also undertakes large-scale diagrams and anatomical charts of farm animals, etc., to order, suitable for lecture purposes.

A shop, supplying small necessities and luxuries to sanatorium patients and staff, supports a female ex-patient who lives on the premises.

The Pig Farm.—The agricultural side of the settlement will, however, be of more particular interest to JOURNAL readers. The pig farm is one of the chief features in this connection, and it was one of the first schemes to be started at Wooley. There were, in all, 25 brood sows and 15 gilts to farrow this spring and, taking an average of 5 per litter, it was hoped to have 200 young pigs to run through the summer. The sows include 21 Large Blacks, 1 Berkshire and 3 pure-bred Cumberlands; and the gilts are pure-bred Large Blacks, showing true breed characteristics. All sows and gilts are mated to pedigree Middle White boars of Histon strain, which gives a cross, seen in 100 porkers of various sizes, of an ideal pork type, attaining early maturity. Most of these porkers were white with blue spots and markings, a colouring which is much favoured in the north-eastern markets. Two men, fully employed at district rates, and three boys, on part-time employment, constitute the staff. One of the settlers is in charge and he supervises all operations, including certain feeding experiments which are now being carried out with a proprietary feeding compound at the instance of the manufacturers. Investigations in regard to "Seedy-cut" have also been undertaken and reported upon.* From these it was deduced that "Seedy-cut" is most probably a developed abnormality in the mammary gland of the pig; also that the black streaks, so frequently noted in the belly wall of the black pig, are, in fact, nothing more than the invaginated epidermis or skin which is a necessary factor in the development of the mammary gland.

The pigs at Wooley, with the exception of those destined for the butcher, are run on the open-air principle. Those being fattened for sale are housed in wooden buildings and are pushed on for the early attainment of about 140 lb. live weight, when they are marketed. The Director of the Settlement has in view a further development of the pig farm, for which there is ample space, which will provide occupation for additional settlers.

Rabbit Farming, both for fur and wool, is practised on a considerable scale. Beginning in a small way, the stock now numbers some 800 rabbits, and with this summer's litters of young ones there is every likelihood of the total reaching well

* See *Pigs*, August, 1923.

over 1,000. There are some hundreds of light and airy hutches, these having small-mesh wire netting floors with sliding zinc trays under. To this provision for speedy and easy cleaning is doubtless due, the absence of smell on the farm which is an unexpected feature to those accustomed to rabbit farms.

Two breeds are kept, Chinchillas for pelt production and Angoras for wool. It was the original intention to restrict the enterprise to these two purposes, but the success of the Settlement rabbits on the show bench, all over England, and the high prices realised for animals for breeding and show purposes, has led to a development on this side. Surplus Chinchillas are pelted, and the making-up and utilisation of the skins for garments, slippers, gloves, etc., is a new and promising branch of the Settlement work.

The chief interest of the rabbit farm, however, is the production of Angora wool, about which the Settlement Director has published a comprehensive treatise ; † and for this wool there is an increasing wholesale demand at 35s. per lb., the exceptional care taken at Wooley in cleaning and grading the product, bringing its reward in the shape of top market price from the mills. The wool is clipped from the rabbits as soon as it has reached the length—four inches—required by the spinners, and, after examination and grading, is packed for transport in air-tight tins as a safeguard against dust and damp.

The recording work in connection with the rabbit farm has been very completely organised. Every rabbit is numbered and has a card in an index system, upon which its full pedigree is recorded, as well as in the pedigree book. Notes are kept of the dates of all matings as well as of the births of litters ; particulars are also recorded of the numbers of each sex of the young ones and the manner in which they are disposed of.

As may be imagined, the food bill for the rabbit farm is an expensive item, but roots and hay for winter feed are grown at the Settlement, and supplies of grass, herbs and weeds, available from the Estate for more than six months in the year go a long way towards keeping the food bill within reasonable limits.

The research side of specialised rabbit farming has not escaped the attention of Dr. McDougall, who is responsible for an investigation into the microscopical structure of the

† " Angora Wool Farming " by J. B. McDougall, M.D., M.R.C.P., published by *Fur and Feather*, Idle, Bradford, price 2s. 3d., post free.

Angora wool fibre, the results of which he communicated in a paper read to the First Rabbit Industry Conference held at Bradford in January of this year. Dr. McDougall has also collaborated with Dr. R. P. Smith and Dr. Laws, of Newcastle, in investigating the infectious disease called "Snuffles," the cause, perhaps, of more losses to rabbit keepers than any other disease to which these animals are subject, and some important conclusions were arrived at.

The Carpenter's Shop of the Settlement may, fittingly, be mentioned here, as all the rabbit hutches and many other fitments of the farm are made in it. The "Wooley" hutch, already briefly described, is made three-tier height for outdoor use, and in modified form for use indoors.

Goats.—The latest Settlement venture, the development of a pedigree herd of milk-recorded goats, has possibilities other than the purely financial gain aimed at with the pigs and rabbits; as, apart from the additional employment that will be provided for settlers, Dr. McDougall desires to include fresh goat's milk in the dietary of his patients. The goat is very resistant to tuberculosis; its milk, in normal circumstances, has a high butter-fat content, and is, usually, more easily digested by delicate persons than cow's milk. The Settlement Estate includes a large dell, overgrown with thickets of blackberry and numerous other shrubs and bushes, relished by goats; and there is a plentiful supply of rough, coarse grass. It is intended to run the goats loose in one herd.

Provision of Funds.—It will probably be asked how the necessary funds for the Settlement Scheme have been raised; and the answer to that question rather gives away the secret of its undoubted success. Apart from a contribution of £1,200 from the British Red Cross Society, the whole of the capital represents voluntary contributions, and over 60 per cent. of these voluntary gifts have come from patients and ex-patients of the Sanatorium. With such enthusiasm on the part of the patients, and the enterprise and careful guiding of the Honorary Director, it is not difficult to understand why the Wooley Sanatorium Settlement Scheme furnishes to other Authorities dealing with tuberculous cases, an example that can be appreciated best by personal visit and first-hand study.

JULY ON THE FARM

J. R. BOND, M.Sc., M.B.E., N.D.A. (HONS.),

Agricultural Organiser for Derbyshire.

Seasonal Notes.—"Plaguy July" this month has been called, because it is a period when there is so much to be done or which wet weather prevents from being done. No doubt the epithet also alludes to the frequent outbreaks of epidemic disease which, before the dawn of bacteriology, used to occur or reach their climax during the hottest month of the year. This particular period of the summer had an ill reputation even in Ancient Rome; it formed the greater part of the canicular or dog-days—July 3 to August 11—when events were believed to be influenced by an evil star, which in that era rose and set with the sun during the days mentioned. The dog-days superstition persisted in our country until, in recent times, observers showed that the coincidence of the dog-star with the sun no longer occurred in July, and rabies and cholera were proved to be virus diseases.

It is in July that in most years the sun attains its greatest power, and this fact has been used to explain why Marc Antony chose the Roman Quinctilis or fifth month for renaming in honour of Julius Cæsar. More probably, however, his reason was because Cæsar was born in this month, and had himself honoured it by increasing its duration to thirty-one days. Our Saxon ancestors called this Heu-monath or hay month, a name which survives in modern Dutch as Hooymaand.

The weather of July has the reputation of being extreme—either very dry or very wet. This behaviour was in former times associated with weather saints, and according to whether the saint day was wet or fine, so would the ensuing forty days be rainy or dry. The fallacy of our own superstition concerning St. Swithin's (July 15) has previously been discussed in these notes; the Belgians had St. Godelieve, July 6; the French observed the weather on St. John's day, June 24; the Germans, St. John's day, or June 27; while Visitation, July 2, had weather significance to people in many parts of Europe. It may seem strange that the period of forty days should be common to the lore of all the above-mentioned nations; but this is probably explained from the frequent use of that period in scriptural narratives.

Operations.—Hay making is, of course, the principal farm operation in July, always provided that weather conditions permit of it. In the later northern and upland districts this work often extends over the following month. After the ricks have stood for a week or two to become partially settled, the loose hay round the outsides should be pulled out and, except under barns, the roof should be raked down and thatched before attention has to be turned to the corn harvest. Overheating may be prevented by reasonable precautions—the use of the stack thermometer and the rick borer. When the temperature is allowed to approach 170° F., there is danger of spontaneous ignition, due to chemical changes which continue after bacteria have been destroyed by the heat. It may be five or six weeks after stacking before an overheating rick reaches the danger point; so any stack that has become too warm should be kept under observation for that period, unless readings from the heart of the mass have shown definitely that the temperature is steadily declining.

The aftermaths of old grass land do not call for attention until some weeks after being cleared, unless owing to crooked fences or dire need of grazing, stock are turned in to find what they can along the hedge bottoms. Sometimes also it is convenient to cart yard manure on to the hay stubble at this stage.

Seeds stubbles intended for winter corn may, according to circumstances, be left until September, or broken up forthwith. Where there is couch or twitch to be eradicated, early ploughing is desirable. The same applies in the southern and midland counties to the prevention of frit-fly attack in winter corn after grassy leas. Early breaking up is, however, likely to be of more importance when the lea has been down for more than one year; a first-year lea containing a good stand of red clover may be too valuable to be sacrificed at this stage. In some districts with low rainfall it is customary to apply the bulk of the yard manure used in the rotation to the lea stubble before ploughing. In this case the turnip crop is grown with artificials only and fed on the land.

Pen-Fallowing.—The operation of working and cleaning land between the harvesting of a crop in June or July and the sowing of the next crop in autumn is known as pen-fallowing or bastard fallowing. On heavy land its adoption may enable the farmer to reduce the frequency of summer fallowing or to grow roots without excessive spring cleaning

operations before sowing. To secure the best results, however, the stubble of the seeds or silage crop must be broken up while in a dry state. This necessitates both suitable weather conditions and the use of mechanical power. Probably the steam cultivator, where it can be hired, is the cheapest as well as the best implement for this purpose. Incidentally, steam cultivation is much more extensively practised in this country than is generally realised: there are about 350 double-engine and 250 single-engine sets now at work. What may prove to be a serious rival to the cable method of high-power working, however, is on the horizon; it is a 70 h.p. rotary tiller, which I have seen at work in Lincolnshire, but not engaged in breaking up hard baked clay; the designer assures me, however, that it is fully equal to that task.

Horse-hoeing.—Potatoes receive their final hoeing and earthing up in July. Root crops—the prospects of which this year promise to improve the values of store sheep—should now have their last and shallow horse-hoeing; and on strong or wet land a light earthing up may be executed to facilitate the harvesting of the bulbs. In the case of sugar beet, the chief object of earthing up is to prevent an excess of green crown. The question of horse-hoeing roots is in certain of its aspects a contentious matter. There are some who believe that this operation is beneficial to the crop in ways other than by checking or destroying weeds, *i.e.*, by æration and by conserving moisture. In a recent discussion one farmer even advised increasing the depth of the operation as the soil moisture receded downwards. Other farmers who have tested that matter are convinced that deep hoeing after the root fibres have begun to spread between the drill rows is injurious to the crop. As regards the alleged moisture-conserving effect of horse-hoeing between root rows, no scientific experiments that are really relevant to the question have been carried out in this country, and the results of American experiments support the practice of the farmer who thinks more about weed killing than about the soil mulch, but who takes care not to destroy the root fibres of the crop plant. The single A-shaped share is preferable to the double L-shaped blades for late work among root crops.

Pastures and Cattle.—On the best feeding pastures forward bullocks now become ready for the butcher, and at this time of the year beef prices reach their maximum. Grass-fattened cattle, however, do not kill quite so well as stall-fed beasts,

unless the grazing has been supplemented with concentrated foods. Most feeders do provide such supplements; but in the absence of experimental proof that linseed and cotton cakes are, under grazing conditions, superior to, say, crushed barley, it is difficult to understand why albuminoid matter should be preferred to carbohydrates for fat production, when the basal ration—good grass—is itself rather high in albuminoids.

For milk production July is not generally such a good month as June. The output of the herd tends to shrink appreciably in July, and cows that calve in this month do not under ordinary management keep up a high daily yield for long or make high total yields in their lactation periods. The herbage may be sufficient in quantity but is apt to become rather benty and fibrous, and even the white clover throws up flower stalks at the expense of leaf production. No doubt the heat also has an enervating effect on the cows, and insects add to their discomfort. Cows managed on the soiling system—kept indoors and fed with green fodder—give higher milk yields than those pastured in the ordinary way at this time of the year; and where phenomenal yields are sought, this method is adopted. In this connection an old practice has recently been advocated, viz., to bring the herd indoors during the hottest part of the day and supply artificial foods. Whether afternoon housing is or is not to be recommended in ordinary dairy farming practice depends on conditions, such as the season, the level of milk yield of the herd, the area, condition and quality of the pasturage, water supply, and shade. If the pastures are burnt up and the cows are gadding, afternoon housing is obviously desirable, not only for the milkers but also for the dry cows heavily in calf. To house the stock, however, merely for the purpose of inducing the cows to eat more concentrates and thereby yield a little more milk may be uneconomical. Under ordinary conditions, however, deep milkers do require additional concentrated food or soiling crops in July. The desirability of sowing marrow-stem kale for use at this time of the year was mentioned in the April notes; but where reliance is placed on concentrates, the typical July allowance is 3½ lb. for each gallon of milk yielded above the first two gallons. First calf heifers may with advantage receive more liberal feeding.

Sheep Maggot Fly.—From June till September the shepherd has to be watchful to keep his flock free from the fly; but

in the close, moist, hot weather which often occurs in this month, when the eggs of the fly hatch out and develop so quickly, more frequent inspection and very prompt attention are needed to prevent serious injury being done. Lambs appear to be more subject to attack than older sheep, and are sometimes struck on parts other than the hindquarters. Sheltered places and fields near woods and hedges are more dangerous in this respect than more exposed country. The necessity of keeping the sheep clean and well "belted" is well known; but, as already mentioned, this alone does not confer immunity.

Dipping is certainly of service as a preventive measure, but its effect in warding off the fly or of killing eggs deposited after the immersion is of short duration, about a fortnight or less in showery weather. Sulphur is regarded as the dip ingredient possessing the protective action. The symptoms of attack are well known—the sheep behaves abnormally, wags its tail or in a bad case rubs and bites and wanders away from its fellows; there is a discoloured patch of wool where the maggots are at work. There is not great difficulty in killing the maggots, if treated early enough. Sheep dip is often used; a mixture of turpentine and rape oil in equal parts is very good; and paraffin is very potent. An old remedy is equal parts of paraffin and milk, which probably meets the suggestion of Dr. Stewart MacDougall (who investigated maggot fly for the Highland Society) that the dressing-oil should not be too strong: if the maggots are killed at once they are difficult to remove from the wool, and sheep so treated will be struck again. It is well to dust sulphur over the affected patches after treatment.

Farm Competitions.—One of the least spectacular but not the least commendable activities of agricultural societies is the holding of competitions for the best cultivated farms. The inspection—or the second inspection where the farms are seen twice—is generally carried out in July. Judging farms at this time of the year, especially when entries are numerous, is a strenuous task; for the conscientious judge endeavours to see every animal, every field and every fence on each holding in the competition, and to weigh the answers given to numerous questions that he must put to the competitors.

Organizers of farm competitions have often sought for a simple formula or criterion to apply in making the awards. It has been suggested that since farms are businesses, the

order of merit in farm competitions should be simply that of the profits as shown by properly audited books. This suggestion is not so simple to adopt as it looks. Assuming that methods of accounting could be agreed upon, there is then the question of whether the criterion should be profit per acre or per cent. on the tenant's capital. Would either basis afford a fair comparison between, say, a farm rented from an old-fashioned landlord, and another holding bought by the occupier in 1920 ? In some respects accounts do not adequately express the difference between the methods of one farmer and another. The apparent profits of a particular year may be distended by "economies" in such matters as hedging, ditching, headlands, hedge bottoms and the acreage under cleaning crops. There are other ways in which the reserves of good husbandry may be temporarily drawn upon but which might be difficult to assess for accounting purposes. On the other hand, the accounts would hardly show the value of work which another farmer might be doing in laying the foundations of an improved herd.

Farm judges are mainly influenced by the productivity of the various holdings, as indicated by the number, condition and merit of the live stock, the vigour of the arable crops, the condition of the pastures, and the yield of the mown land as shown by the quantity of fodder in the stacks. If excellence in these matters is combined with forwardness of operations, freedom from weeds, well-kept fences and gates, and general neatness about the homestead, it is difficult to criticise the visible results of the management. Yet such a farm may be known to be run at a loss, when neighbouring holdings were being made to yield a living. Such cases are difficult to decide. British agriculture needs holdings run for purposes other than monetary gain ; and where loss is attributable to the pursuit of information likely to be of benefit to farmers generally—as the testing of new methods—due allowance and credit should be given to the competitor.

The judge of farms has thus to weigh many considerations in arriving at his decisions. He is happy when he can find for the premier award some competitor who approaches his ideal farmer—one who is doing as well for himself as economic cond tions will permit, but who is also doing rather more than his duty by the other interests concerned in the farming industry—finding employment for and retaining the services of a good staff of labourers, improving the rentability of the holding, and contributing in sundry ways to the advancement of agriculture in general and of local practice in particular.

MONTHLY NOTES ON FEEDING STUFFS

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Accessory Aids to Digestion and Nutrition.—In preparing foods for animals, substances are often added for the purpose of making the ration more palatable, to disguise an objectionable flavour, to correct a tendency the food may otherwise have towards causing looseness of the bowels or the reverse, or to supplement the mineral deficiencies of the diet. Such substances have rarely any food value in themselves, and it becomes interesting to ascertain to what extent their use is justified in farming practice. The addition of salt to badly cured or musty hay, and the addition of molasses to straw, will cause animals to eat greedily what they would otherwise reject, and in times of shortage their use for this purpose is perhaps justifiable. Such materials used for this purpose are comprised under the general term condiments, and include such substances as gentian, juniper, aniseed, and fenugreek. Wisely used, condimental aids of this nature may be considered good farming practice, in that they enable the farmer to deal with unpalatable mixtures with good results. Their general use on the farm, however, is unsound for the following reasons: (1) The condiments are being used for sound and healthy animals whose normal appetite should not need such adventitious aid; (2) one of the first symptoms of disease in farm animals is a failing appetite, and if condiments are used, this first symptom may be suppressed until the animal's health is so seriously undermined as to jeopardise the possibility of subsequent recovery; (3) the stockman is tempted to neglect that most important part of his duties, keeping the animal on full feed by giving suitable mixtures of feeding stuffs. Arranging foods into mixtures which will keep the animals in good health, will keep them feeding eagerly, and which are properly balanced, is an art in itself, and automatically ensures that the foods are being economically and wisely used. Finally, science teaches us that the addition of condiments does not lead to increased digestibility of the food. The cost of the condiment is consequently, under normal conditions and excluding molasses, an unnecessary addition to the food bill.

Mineral Condiments.—Apart from condiments in the strict sense, there is also that class of substances comprising salt, chalk and calcium phosphate in various forms, that are added to foods to balance the other constituents of the diet. With the general use of salt, chalk, and phosphate for feeding,

DESCRIPTION	Price per qr. s. d	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv per 100 lb	Price per unit starch equiv. s. d.	Price per lb. starch equiv d.	Protein equiv. %
Wheat, British..	—	—	14 0	0 15	13 5	72	3 8	1 96	9 6
Barley, British feeding .	—	—	9 5	0 12	8 13	71	2 5	1 29	6 2
„ Canadian No 4 Western	31 6	400	8 17	0 12	8 5	71	2 4	1 25	6·2
„ American .. .	31 0	„	8 13	0 12	8 1	71	2 3	1 20	6 2
„ Russian .. .	30 9	„	8 12	0 12	8 0	71	2 3	1 20	6·2
Oats, English, white .. .	—	—	10 7	0 13	9 14	60	3 3	1·74	7·6
„ „ black and grey	—	—	9 13	0 13	9 0	60	3 0	1 61	7 6
„ Scotch, white .. .	—	—	10 17	0 13	10 4	60	3 5	1 83	7 6
„ Canadian No. 2 Western	30 3	320	10 12	0 13	9 19	60	3 4	1 78	7·6
„ „ No. 3 „ .	27 3	„	9 10	0 13	8 17	60	2 11	1 56	7·6
„ „ feed	26 3	„	9 3	0 13	8 10	60	2 10	1 52	7 6
„ American	26 0	„	9 2	0 13	8 9	60	2 10	1 52	7·6
„ Argentine ..	26 3	„	9 3	0 13	8 10	60	2 10	1 52	7 6
„ Chilian .	26 0	„	9 2	0 13	8 9	60	2 10	1 52	7 6
Maize, Argentine .. .	30 6	480	7 2	0 12	6 10	81	1 7	0 85	6 8
„ South African .. .	31 9	„	7 8†	0 12	6 16	81	1 8	0 89	6·8
Beans, English winter.	—	—	11 0	1 11	9 9	66	2 10	1 52	20 0
Peas, „ dun .	—	—	11 10	1 7	10 3	69	2 11	1 56	18 0
„ „ maple	—	—	11 13	1 7	10 6	69	3 0	1 61	18 0
Millers' offals—									
Bran, British .. .	—	—	5 15	1 6	4 9	42	2 1	1 12	10 0
„ broad	—	—	7 0	1 6	5 14	42	2 9	1 47	10 0
Middlings, fine, imported .	—	—	7 17	1 1	6 16	69	2 0	1 07	12 0
„ coarse, British	—	—	6 10	1 1	5 9	58	1 11	1 03	11 0
Pollards, imported .. .	—	—	6 0	1 6	4 14	60	1 7	0 85	11 0
Meal, barley	—	—	10 5	0 12	9 13	71	2 9	1 47	6 2
„ maize	—	—	8 15	0 12	8 3	81	2 0	1·07	6·8
„ „ South African	—	—	8 0	0 12	7 8	81	1 10	0 98	6 8
„ „ germ .	—	—	7 10	0 18	6 12	85	1 7	0 85	10 0
„ „ gluten feed	—	—	9 2	1 6	7 16	76	2 1	1 12	19 0
„ locust bean .. .	—	—	9 5	0 9	8 16	71	2 6	1 34	3 6
„ bean	—	—	12 5	1 11	10 14	66	3 3	1 74	20 0
„ fish . ..	—	—	18 0	4 1	13 19	53	5 3	2 81	48 0
Maize, cooked flaked .. .	—	—	10 5	0 12	9 13	85	2 3	1·20	8 6
Linseed—									
„ cake, English, 12% oil	—	—	11 17	1 16	10 1	74	2 9	1 47	25 0
„ „ „ 10% „	—	—	11 10	1 16	9 14	74	2 7	1 38	25 0
„ „ „ 9% „	—	—	11 5	1 16	9 9	74	2 7	1 38	25 0
Soya bean „ 6% „	—	—	11 0	2 11	8 9	69	2 5	1 29	36 0
Cottonseed cake, English, 5½%„	—	—	6 15	1 13	5 2	42	2 5	1 29	17 0
„ „ Egyptian, 5½% „	—	—	6 0	1 13	4 7	42	2 1	1 12	17 0
Decorticated cottonseed cake, 7% oil	—	—	10 0	2 11	7 9	71	2 1	1 12	34 0
Decorticated cottonseed meal, 7% oil	—	—	10 10	2 11	7 19	74	2 2	1 16	35 0
Coconut cake, 6% oil ..	—	—	8 10	1 10	7 0	79	1 9	0 94	16·0
Ground nut cake, 6-7% oil	—	—	8 5	1 15	6 10	57	2 3	1·20	27 0
Decorticated ground nut cake, 7% oil	—	—	11 10*	2 13	8 17	73	2 5	1 29	41 0
Palm kernel cake, 6% oil	—	—	6 10	1 2	5 8	75	1 5	0 76	17 0
„ „ „ meal, 6% oil	—	—	7 0	1 2	5 18	75	1 7	0 85	17 0
„ „ „ meal, 2% „	—	—	5 10	1 3	4 7	71	1 3	0 67	17 0
Feeding treacle. . .	—	—	6 12	0 9	6 3	51	2 5	1 29	2·7
Brewers' grains, Dried ale	—	—	6 5	1 3	5 2	49	2 1	1 12	13 0
„ „ „ porter	—	—	5 15	1 3	4 12	49	1 11	1 03	13 0
„ „ Wet ale	—	—	0 15	0 9	0 6	15	0 5	0 23	4 8
„ „ „ porter	—	—	0 10	0 9	0 1	15	0 1	0 05	4·8
Malt culms	—	—	6 0	1 13	4 7	43	2 0	1 07	16 0

* At Hull † At Liverpool

NOTE—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store The prices were current at the end of May and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes Thus, suppose palm kernel cake is offered [illegible]

is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 3d , P_2O_5, 3s. 8d ; K_2O, 3s. 0d.

readers of these notes are already familiar. In the case of salt, the free choice method of allowing access to lump rock-salt is the best; in the case of chalk, the following daily maximum doses may prove of value as a general guide: lambs ¼ oz., sheep ½ oz., pigs ½-¾ oz., calves 1 oz., horses, milch cows and bullocks 2-3 oz. In the case of phosphate, in the form of steamed bone meal, the maxima are as follows: sheep ¾-1 oz., young growing pigs 1 oz., full-grown pigs 1½ oz., calves 2 oz., horses, milch cows and bullocks 5-10 oz. In using these figures as a guide, it must be remembered that these figures form maxima, and that the actual amounts required will vary according to the nature of the diet. Under some conditions the addition of mineral substances may even prove the reverse of beneficial.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch equivalent	Protein equivalent	Per ton £ s.
Barley (imported)	71	6·2	8 14
Maize	81	6·8	7 5
Decorticated ground nut cake	73	41·0	11 10
„ cotton cake	71	34·0	10 0

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2·05 shillings, and per unit protein equivalent, 2·05 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1925, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	8 7
Oats	60	7·6	6 18
Barley	71	6·2	7 18
Potatoes	18	0·6	1 18
Swedes	7	0·7	0 16
Mangolds	7	0·4	0 15
Beans	66	20·0	8 16
Good meadow hay	31	4·6	3 13
Good oat straw	17	0·9	1 16
Good clover hay	32	7·0	4 0
Vetch and oat silage	13	1·6	1 10
Barley straw	19	0·7	2 0
Wheat straw	11	0·1	1 3
Bean straw	19	1·7	2 2

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Bristol	Hull	L'pool	London	Cost per unit at London
	Average price per ton during week ended May				
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	14 2	13 10	13 7	13 10	17 5
„ lime (N. 13%) ..	..	12 10	..	12 7‡	19 0
Sulphate of ammonia—					
Neutral (N. 21·1%)	13 1*	13 1*	13 1*	13 1*	(N)12 4
Kainit (Pot. 20%)	..	3 0	..	..	..
„ (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	3 12	..	3 9	3 3	3 2
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51½%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 38%)	3 17	..	..	3 17§	2 1
„ (T.P. 36%)	3 12	..	..	3 13§	2 0
„ (T.P. 34%)	..	..	3 8§	..	..
„ (T.P. 30%)	..	2 15§	2 18§	..	..
„ (T.P. 28%)	..	2 9§	..	..	..
„ (T.P. 26%)	..	2 3§	..	..	..
„ (T.P. 24%)	..	1 19§	1 19§	..	..
Ground rock phosphate (T.P. 58%)	2 17¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 14	3 5	1 10
„ (S.P. 33%) ..	..	..	3 11	..	..
„ (S.P. 30%) ..	3 0	2 17	3 7	2 18	1 11
Bone meal (N. 3½%, T.P. 45%) ..	8 15	8 5	8 10	7 15	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 2†	6 10†	5 15	5 10	..
Fish guano (N. 6½%, T.P. 10%) ..	..	..	..	7 17	..

Abbreviations: N.—Nitrogen; S.P.—Soluble Phosphate; T.P.—Total Phosphate; Pot.—Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in the home counties.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the Home Counties.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton.

MISCELLANEOUS NOTES

Exchange of British and Danish Agriculturists

UNDER the scheme of exchange arranged between the Ministry and the Danish Government a limited number of young agriculturists from this country were afforded an opportunity in 1924 and 1925 of visiting Denmark and of obtaining practical experience of Danish agriculture. Similarly, in each year, an equal number of young Danish agriculturists were selected under the scheme to come to this country for the purpose of gaining an insight into the practice of English agriculture. The students were required to pay their own travelling expenses to and from their destination, and to undertake regular work on a farm, for a period of from three to six months, in return for free board and lodging. No money was payable to them. The National Farmers' Union gave assistance in the selection of farms where Danish students could be received, and in securing suitable British applicants for work on Danish farms.

The scheme would appear to have served a very useful purpose in the past, and the Ministry has accordingly decided to continue it, on the same lines, during 1926. Applications from young agriculturists in England and Wales wishing to participate in the scheme may be sent to the Ministry, and will be transmitted to the Agricultural Commissioner of the Danish Government.

Veterinary Tests for Poultry Diseases

THE Ministry carries out post-mortem examinations of poultry, agglutination tests for bacillary white diarrhœa, and other bacteriological work in connection with poultry, at its veterinary laboratory. It is open to poultry keepers whose birds are dying mysteriously, or who have other evidence of the existence of disease in their flocks, to obtain an expert diagnosis of the disease, and certain other services, from the laboratory. Such work cannot be undertaken, however, in cases where owners have no special reason to suspect that their poultry are infected with disease. The staff and accommodation available at the laboratory for work in connection with poultry is limited, and it is necessary to ensure that the important work of research in connection with poultry diseases is not hindered. The laboratory, therefore, finds it

impossible at present to undertake the work of applying the agglutination test for bacillary white diarrhœa to any considerable number of birds from flocks in which the disease has not been diagnosed already.

In this connection the Ministry wishes to point out that the agglutination test is only desirable for the detection of carriers of bacillary white diarrhœa among breeding stock. It is inadvisable and unprofitable to apply it for the elimination of infection from among chickens which have survived an outbreak. Moreover, the carrying out of one agglutination test of an infected flock and the elimination of carriers thus identified does not guarantee that B.W.D. has been eradicated. To be reasonably certain that all infection has been eliminated, all the birds must at the same time give negative reactions to two successive tests. The statement, therefore, which is sometimes made, that every fowl in a flock has been tested by the Ministry does not necessarily mean that the flock is free from infection.

Fees.—The charge for an ordinary post-mortem examination is 3s. per bird. In the case of birds sent from egg-laying trials for post-mortem or other examination, a reduced fee of 2s. per bird is charged.

In cases where flocks are suspected of being infected with bacillary white diarrhœa an inclusive fee of 10s. is charged for a diagnosis. This fee covers whatever laboratory tests are required to establish, or otherwise, the existence of the disease. In cases, therefore, where chicks have died in considerable numbers, several specimen chicks should be sent for examination as soon as possible after death, in order to provide sufficient material for the laboratory tests. If further material is required the laboratory will ask for it, but will make no charge beyond the prescribed fee of 10s.

In flocks where bacillary white diarrhœa has been found to exist, samples of the blood of the adult birds will be tested at the laboratory for elimination purposes at an additional fee of 1s. per bird up to forty, and at the rate of 6d. for every bird in excess of that number. Instructions as to the taking of blood samples in such cases will be supplied to applicants from the laboratory.

Directions for Dispatch of Birds.—(1) In all cases fees are payable in advance.

(2) Birds should be sent direct to the Veterinary Laboratory, New Haw, Weybridge, Surrey (Station: Addlestone, Southern

Railway). *Carriage must be prepaid. Birds should in all cases bear the name and address of the sender clearly written.*

(3) Notification of dispatch should be posted separately at the same time to the laboratory. Such notification should be accompanied by the necessary remittance. Postal orders and cheques should be made payable to "The Ministry of Agriculture and Fisheries," and be crossed "Bank of England." Postage stamps cannot be accepted.

(4) All communications relating to birds submitted for post-mortem or other examination should be addressed to *The Manager*, Ministry's Veterinary Laboratory, as above, *and not to any person by name.*

* * * * * *

The Fream Memorial Prize

THE Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Diploma in Agriculture, has been won this year by Mr. James A. Gilchrist, a student of the Glasgow and West of Scotland Agricultural College and Glasgow University. The value of the prize this year is about £7, which is to be devoted to the purchase of books.

* * * * * *

Handbooks of Milk Recording Societies

THE Ministry has from time to time published reports on the progress of its Milk Recording Scheme which was inaugurated in 1914, and which operated through sixteen societies during the first year, and through forty-nine societies during the current milk recording year. The general progress which the movement has made is indicated by the fact that there is now no part of the country outside the scope of a milk recording society. The object of the scheme is educational inasmuch as it is intended to demonstrate to the farmer the means by which he can acquire the knowledge necessary to enable him to judge the milk yielding value of his cows. While the scheme is concerned primarily with the practice of simple recording, *i.e.* keeping a record of the milk yield of each cow, it provides assistance and encouragement to the farmer in any excursion into allied questions such as rationing and grading up which his awakened interest may stimulate.

In pursuance of these educational functions the milk recording societies operate on uniform lines laid down in the Ministry's regulations, and in return they receive from the Ministry

certain financial assistance and the advice of the Ministry's Live Stock Officers. It should be realised, however, that in its operations under the scheme an individual milk recording society becomes essentially a business concern, and that its success depends upon the degree in which it can enlist the co-operation of its members in carrying out the rules and regulations, and in availing themselves of the educational advantages provided by the scheme. There has been, as might be expected, considerable difference between the various societies in the measure of progress made. Several societies have shown quite remarkable growth and have established themselves on a businesslike footing both financially and otherwise. A feature which indicates this progress, and which has interested the Ministry not a little, is the annual publication of handbooks which, in addition to giving a list of members, financial position in the year, and otherwise recording the activities of the society, contain articles of interest to the members and to the farming industry generally. In some cases the handbook is published by the Society itself, but the Ministry understands that in many cases arrangements have been made by the Society with the publishers by which the handbook is printed and produced at little or no cost to the Society, the cost being largely secured by a revenue from advertisements. This enterprise, for such it is, has apparently proved successful, as the number of societies issuing such handbooks is increasing. The Ministry regards these handbooks as evidence of businesslike operations, and of expanding interest on the part of members in the objects and practical advantages of the scheme.

The following notes on the various handbooks received by the Ministry in respect of the year 1925 may be of interest, and it may be added that in most cases a copy of the handbook may be obtained free of charge from the Secretary of the milk recording society concerned:—

Berkshire Milk Recording Society (*Secretary: E. D. C. Neal,* 160 *Friar Street, Reading*)

This handbook contains articles on the Guernsey, Dairy Shorthorn, Red Poll and British Friesian Breeds, a brief résumé of the results of experimental work in regard to Milk Fever by H. C. Wright M.A., Ph.D., of the University College, Reading, and articles on the "Production of Clean Milk," on the object and methods of "Calf Rearing Competitions," by J. Mackintosh, O.B.E., N.D.A., of Reading University, and on "Dairying on Grass and Mixed Farms," by J. S. Simpson, B.Sc., Reading University.

Cambridge and District Milk Recording Society (*Secretary: J. S. Penicud,* 10 *Corn Exchange Street, Cambridge*)

Articles on the Dairy Shorthorn and Lincoln Red Shorthorn Breeds appear in this handbook together with articles on the "Value of Clean

Milk Competitions," "Some Aspects of the Dairy Industry" with particular reference to the value of the Red Poll Breed in milk and baby beef production. There is also an article on the value of milk recording by Mr. R. Boutflour, B.Sc., Wilts County Agricultural Officer.

Denbigh and Flint Milk Recording Society (Secretary: T. A. Owen, Coleshill, Bagillt, Chester)

This Society's Annual Report contains notes on the Dairy Shorthorn, Lincoln Red, British Friesian, and Red Poll Breeds and on Clean Milk Production and Clean Milk Competitions.

Dorset Milk Recording Society (Secretary: T. R. Ferris, M.Sc., N.D.D., County Offices, Dorchester)

This handbook contains articles on the Dairy Shorthorn, British Friesian, Red Poll and Guernsey Breeds. Among the other subjects dealt with at some length are "Feeding of Dairy Cows," by T. R. Ferris, M.Sc., N.D.D., Director of Agriculture for Dorset, "Clean Milk and its production" by D. R. Edwardes-Ker, O.B.E., M.A., B.Sc., Seale Hayne Agriculture College, Newton Abbot, "Refrigeration on the Dairy Farm" and "The Tuberculin Test," by J. B. Manuel, M.R.C.V.S. Mr. Boutflour's article on Milk Recording appears also in this Handbook.

East Devon Milk Recording Society (Secretary: J. P. Bishop, Whimple, Devon)

At the Seventh Annual Meeting of this Society the County Agricultural Organiser, C. D. Ross, B.Sc., gave an interesting lecture on "Breeding for Milk Production," which is printed in this Society's handbook. Articles on the Guernsey and Devon Breeds are also included, together with extensive "Notes on Calf Rearing," by the County Organiser. "Clean Milk and Its Production" is also dealt with, and the subject of cow housing is discussed under the title of "The Cow's Palace," by J. B. Goddard, N.D.A., L.D.A.

Essex Milk Recording Society (Secretary: Wm. Porter, Mayland, Chelmsford)

This handbook contains articles on the Dairy Shorthorn, Red Poll, Kerry, and Lincoln Red Breeds and "Advice to Beginners on the formation of a Friesian Herd." There is also an article on "Clean Milk Production" and on "Milk Recording," by R. Boutflour, B.Sc., together with a review of the work of the East Anglian Institute of Agriculture under the heading "Agriculture Education in Essex."

Hampshire Milk Recording Society (Secretary: E. Rogers, Spencer House, Petersfield).

This Society's Annual Report and Year Book contains articles on the following subjects:—"Solids in Milk," by J. M. Templeton, B.Sc., Assistant County Organizer for Hampshire, "Bovine Tuberculosis," by J. F. D. Tutt, M.R.C.V.S., "Some Advantages of Recording and Rationing," "Feeding and Management of Dairy Cows after Calving," by R. Boutflour M.Sc.

There is also an interesting reference to Vancouver's Survey of Hampshire, 1810, which cites two instances of recording as long ago as 1797. A cow of the Norman breed in ten months and twenty days gave 1,336 gallons, two quarts and half a pint of milk, beer measure, which at 2d. per quart sold for £44 11s. 0½d. Another cow also of the Norman breed, but of less size, yielded from 15 to 16 lb. of butter for several weeks after calving.

(Note.—The Guernsey is descended from the Norman breed).

Hertfordshire Milk Recording Society (Secretary: D. J. Rumbold, 2 Bull Plain, Hertford)

This Handbook contains the following articles:—"The Importance of Minerals in Feeding," by H. W. Gardner, B.A., "Cream and Cream

Cheesemaking on a Milk Selling Farm," by Miss D. M. Peacock, N.D.D., Herts Institute of Agriculture, "Clean Milk and How it can be Produced," by A J. Clare, "A note on Marrow-Stemmed Kale," by J. Hunter-Smith, B.Sc. There are also notes on the utilisation of Bull Calves on milk selling farms and on the Red Poll as a dual purpose breed.

Somerset and North Dorset Milk Recording Association (Secretary R. J. Kerr, Church House, Church Street, Yeovil, Somerset)

The Handbook contains articles on "The Feeding of Dairy Cows," by T. R Ferris, M Sc , N D D , Director of Agriculture for Dorset, "Refrigeration on the Dairy Farm," "The Mineral Needs of Dairy Cows," by J. W. Dallas, M.Sc , Assistant County Organizer for Somerset, and "Clean Milk Production" There is also a series of notes by various writers for the guidance of beginners on the formation of herds of the following breeds Jersey, Guernsey, British Friesian, Dairy Shorthorn and Devon

Suffolk Milk Recording Society (Secretary B A Steward, County Hall, Ipswich)

As might be expected in this Society's Handbook there is an article on the Red Poll Breed Articles are also included on the British Friesian and Dairy Shorthorn Breeds Mr R Boutflour's article on the "Feeding and Management of Dairy Cows after Calving" is also given, and notes on "Methods of Feeding Cows, suited to Suffolk Conditions," by A W Oldershaw, Agricultural Organizer

Worcestershire Milk Recording Society (Secretary W A C. Moule, 28 Evesham Street, Redditch)

This Society's Handbook contains Mr R Boutflour's article on Milk Recording, and the notes on Milk Fever (N C Wright, M A., Ph.D.) and on the Tuberculin Test (J B Manuel, M R C V.S) mentioned above There are also articles on the "Dairy Shorthorn, Lincoln Red, Red Poll and Friesian Breeds"

In addition to the articles noted above these handbooks contain a financial statement for the year and a report on the various activities of the Society This report is often of considerable interest inasmuch as it includes particulars of the performances of the various herds and of cows of ourstanding merit In some cases too a report on clean milk competitions, herd competitions and calf rearing competitions is also given. The Ministry commends the enterprise and care shown in the preparation of these handbooks, which cannot fail to stimulate interest among the members and others who receive copies

A number of societies not mentioned above also publish handbooks, but the volume relating to the milk recording year ended October 1, 1925, has not yet been received by the Ministry The various subjects dealt with in these handbooks indicate that societies have passed beyond the elementary stage of simple milk recording, and are giving serious attention to the related questions, a knowledge of which is essential if any real "grading up" of dairy herds is to be accomplished

Farm Workers' Minimum Wages.—Meetings of the Agricultural Wages Board were held on June 1 and 10 at 7 Whitehall Place, S W 1, the Chairman, Lord Kenyon, presiding

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages,

and proceeded to make the following Orders carrying out the Committees' decisions

Hampshire and Isle of Wight.—An Order fixing special minimum rates of wages for male workers for overtime employment on the corn harvest, the rate in the case of workers aged 21 years and over being 9d per hour

Hertford.—Orders fixing special minimum rates of wages for employment on the hay and corn harvests In the case of the hay harvest the special rate applies only to all overtime employment, the rate in the case of male workers aged twenty one years and over being 10d per hour The special rate for the corn harvest applies to all employment on harvest work, the rate in the case of male workers aged twenty-one years and over being 10½d per hour

Norfolk —An Order revising the minimum and overtime rates of wages for male and female workers in Norfolk, to come into operation on Monday, June 7, and to continue up to December 31, 1926 In the case of male workers aged twenty one and over the new Order increases the minimum rates to 30s per week of fifty hours in summer (first Monday in March to first Sunday in November), and of forty-eight hours in winter (remainder of the year), as against 29s per week in summer and 28s per week in winter as hitherto The Order continues unchanged, the additional sums payable to special classes of workers, which in the case of such workers aged eighteen years and over are 5s 6d for teamsmen, cowmen, and shepherds, and 4s 6d for sheep-tenders or bullock tenders The minimum rate for female workers aged eighteen years and over remains unchanged at 5d per hour The overtime rates for male workers aged twenty one years and over are 9d per hour on weekdays and 11d per hour on Sundays, and in the case of female workers aged eighteen years and over, 6½d. per hour on weekdays and 7½d. per hour on Sundays

An Order was also made fixing special minimum rates of wages for work on the corn harvest in Norfolk In the case of male workers employed for the full harvest an inclusive wage is fixed to cover the harvest month, the amount in the case of workers aged twenty-one years and over being £11, as against £12 last year In the case of workers who do not work the full harvest the Order provides that they should be paid at the ordinary minimum rate with overtime payment at a special rate, the differential overtime rate fixed for the purpose being in the case of workers aged twenty-one years and over 9½d per hour

Shropshire —An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on June 7 The Order increases the minimum rate for male workers of twenty-one years of age and over from 31s 6d to 32s 6d, the number of hours on which the wage is based being continued at fifty-four per week The overtime rate for male workers aged twenty-one years and over is 9d per hour The rates for female workers remain unchanged, the rate in the case of workers aged eighteen years and over being 5d per hour with overtime at 6d. per hour

Somerset —An Order to come into operation on June 14 fixing special rates of wages for male workers for overtime employment on the hay and corn harvests, the rate in the case of workers aged twenty-one years and over being 10d. per hour.

West Riding of Yorkshire —An Order to come into operation on June 14 varying certain of the expressions used in the current Order fixing minimum and overtime rates of wages for male and female workers, the rates themselves remaining unchanged.

Anglesey and Carnarvon.—An Order to come into operation on June 16 varying the current Order fixing minimum and overtime rates for male workers and minimum rates of wages for female workers. The rates for male workers of eighteen years and over employed as horsemen, cowmen, shepherds or hwsmyn (bailiffs) remain unchanged, but new rates, on the same basis of fifty-eight hours per week, are fixed for such workers of sixteen and under eighteen years of age. The Order also provides for an increase in the rate for male workers of twenty-one years of age and over, other than the special classes, to 31s. per week of fifty hours.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

Enforcement of Minimum Rates of Wages.—During the month ended June 15, legal proceedings were instituted against eleven employers for failure to pay the minimum and overtime rates of wages fixed by Orders of the Agricultural Wages Board for workers employed in agriculture.

Particulars of the cases are as follows:—

County	Court	Fines	Costs	Arrears of wages ordered to be paid	No. of workers concerned
		£ s. d.	£ s. d.	£ s. d.	
Warwick	Shipston-on-Stour	2 0 0	–	6 7 7	2
Notts	Retford	3 15 0	15 0	13 0 0	2
Hereford	Ledbury	5 0 0	–	18 4 9	1
Bucks	Slough	57 0 0	– –	93 3 2	10
Salop	Bridgnorth	2 0 0	2 14 10	36 0 3	2
Sussex	Battle	1 0 0	6 0	4 6 3	1
Staffs	Newcastle-under-Lyme	– –	10 5 0	8 18 7	4
Yorks, W. R.	Rotherham	–	5 0	18 0 0	1
Dorset	Sturminster Newton	5 0 0	1 11 0	15 11 2	2
,,	Cranborne	10 0 0	6 14 0	17 7 7	4
Berks	Faringdon	12 0 0	2 3 0	– –	3

In the case heard at Faringdon the arrears of wages (amounting to £57) had been paid by the employer to the workers before the hearing of the case.

Foot-and-Mouth Disease.—Since May 21 there have been 16 outbreaks of foot-and-mouth disease, which have all occurred in new areas.

A new centre of disease was discovered at Carluke in Lanarkshire on May 22, and 13 outbreaks in all have been confirmed in that area. Single outbreaks have also been confirmed during the month at Carlisle, Cumberland, at Thornhill, Dumfriesshire, and at Kilmarnock, Ayrshire.

There have now been 91 outbreaks since January 1, 1926, involving 19 counties, and the slaughter of 1,884 cattle, 8,546 sheep, 1,395 pigs, and 3 goats.

ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Bjanes, O. T.—Norwegian Agriculture. (123 pp. illustrated.) Oslo: J. W. Cappelens Forlag, 1926. [63 (481).]

Nicholls, H. A. A.—Manual de Agricultura Tropical. Tercera Edicion. Traducido de Ingles por *H. Pittier*. (348 pp.) Friburgo de Brisgovia (Alemania): Herder & Cia, 1926. [63 (024).]

Shull, A. F.—Heredity. (287 pp.) New York and London: McGraw-Hill Publishing Co., 1926. 15s. [575.1.]

Ontario Department of Agriculture.—Bulletin No. 313.—Soil Acidity and Liming. (32 pp.) Toronto, 1925. [63.113; 63.15.]

Board of Education.—Rural Education. Adaptation of Instruction to the needs of Rural Areas. A Survey of the Present Position. [Education Pamphlets No. 46.] (59 pp.) London: H.M. Stationery Office, 1926. 6d. [37 (42); 371.]

Board of Education.—Report of H.M. Inspectors on the Educational Work of Women's Rural Institutes. (22 pp.) London: H.M. Stationery Office, 1926, 6d. [376.]

U.S. Department of the Interior, Bureau of Education.—Land-Grant College Education, 1910 to 1920. Part III Agricultural Education in Land-Grant Colleges. [Bulletin 1925, No. 4.] (108 pp. + 8 pl.) Washington, 1925, 25c. [37 (73); 378.]

Ruston, A. G., and *Dawe, C. V.*—Farm Calculations and Accounts. Including a thorough treatment of agricultural calculations and of the business transactions of the farm. (232 pp.) London: University Tutorial Press, 1926. 3s. 6d. [51.]

Ruston, A. G., and *Dawe, C. V.*—Farm Measurements. A Practical Treatment of Problems in Mensuration. (173 pp.) London: University Tutorial Press, 1926. 2s. 6d. [51.]

Midland Agricultural and Dairy College.—Bulletin No. 6:—The Interpretation of Farm Accounts. By *J. S. King*. (16 pp.) Sutton Bonington, 1926. [657.]

Woytinsky, W.—Die Welt in Zahlen. III Buch—Die Landwirtschaft. (320 pp.) Berlin: Rudolf Mosse, 1926. [31 (00).]

Field Crops

Ministry of Agriculture and Fisheries.—Wheat-Breeding Investigations at the Plant Breeding Institute, Cambridge. By *Prof. Sir R. H. Biffen* and *F. L. Engledow*. [Research Monograph No. 4.] (114 pp. + 24 pl.) London, 1926. Cloth boards, 4s.; Quarter bound, 3s. 3d.; Paper covers, 2s. 6d. [575.4; 63.311.]

Leeds University and Yorkshire Council for Agricultural Education.—Bulletin No. 145:—Results of Experiments in Yorkshire in 1925. Variety Trials with Cereals, Potatoes, Swedes, Mangels, and Sugar Beet. Manuring and Singling Trials with Sugar Beet; Source of Seed Trial with Potatoes. (20 pp.) Leeds, 1926. [63.31; 63.332; 63.3433; 63.512.]

The Growing of Lucerne.—Being the Report of a Conference held at Rothamsted on January 7, 1926, under the Chairmanship of Sir John Russell. With contributions by Sir John Russell, H. G. Thornton, A. Cunningham, J. Mackintosh, etc., etc. (32 pp.) London: Benn, 1926, 1s. 6d. [63.33.]

Aberdeen, North of Scotland College of Agriculture.—Bulletin No. 30:—Report on Grass Seed Mixtures, 1907-13. (2nd edition abridged.) With some observations regarding more recent trials. By *W. M. Findlay*. (75 pp.) Aberdeen, 1926. [63.33.]

Sutton & Sons.—Plant-Breeding and Research in Grasses and Clovers at Messrs. Sutton & Sons' Experimental Station, Slough, including ground plans and schedule of experiments. (32 pp.) Reading: Sutton & Sons, 1926. [63.33; 63.1952.]

Fruit

East Malling Research Station.—Apple Pruning. Summary of Deductions from Experiments at East Malling, *N. H. Grubb.* (7 pp.) East Malling, 1925. [63.41-195.]

Cawthron Institute, New Zealand.—Cold Storage Investigations with Apples and Pears. Season, 1925. [Chemistry Dept. Bulletin No. 1, New Series.] (16 pp. + 3 pl.) Nelson, N.Z., 1926. [664.85.]

Plant Pests and Diseases

Leeds University and Yorkshire Council for Agricultural Education.—Bulletin No. 143:—The Slug Pest. (14 pp.) Leeds, 1926. [63.264.]

Appel, Otto.—Taschenatlas der Kartoffelkrankheiten.
I. Teil.—Knollenkrankheiten. (24 coloured plates and 30 pp.)
II. Teil.—Staudenkrankheiten. (20 coloured plates and 24 pp.)
Berlin: Paul Parey, 1925-26. [63.23-33; 63. 24-33; 63. 27-33.]

U.S. Department of Agriculture.—Farmers' Bull. 1478:—Apple Scab (*Venturia inaequalis*). (11 pp.) Washington, 1926. [63.24.]

U.S. Department of Agriculture.—Dept. Bulletin No. 1383:—Single-Bath Hot-Water, and Steam Treatments of Seed Wheat for the Control of Loose Smut. (27 pp.) Washington, 1926. [63.24.]

Morton, J. W.—Practical Spraying. (48 pp.) London: Benn, 1926. 2s. 6d. [63.294.]

Washington Agricultural Experiment Station.—Bulletin No. 197:—Investigations on Oil Sprays. (19 pp.) Pullman, 1926. [63.295.]

Live Stock

Leeds University and the Yorkshire Council for Agricultural Education.—Bulletin No. 144:—The Cost of Grazing. *A. G. Ruston* and *R. S. Critchley.* (32 pp.) Leeds, 1926. [63.33; 63.6043.]

Glasgow, West of Scotland Agricultural College.—Bulletin No. 105:—Pig Feeding. Indoor versus Outdoor Fattening. By *W. G. R. Paterson.* (Reprinted from Trans. Highland and Agricultural Society of Scotland, 1925.) (9 pp.) Glasgow, 1925. [63.64.043.]

Midland Agricultural and Dairy College.—Bulletin No. 7:—Report on Experiments with the Feeding of Pigs. By *H. G. Robinson.*
(a) Feeding of Whey.
(b) Meat Meal, Fish Meal and Soya Meal.
(10 pp.) Sutton Bonington, 1926. [63.64.043.]

Northern Ireland Ministry of Agriculture.—Leaflet .35:—The Fattening of Pigs. (10 pp.) Belfast, 1926. [63.64.043.]

Arkansas Agricultural Experiment Station.—Bulletin No. 198:—Protein Supplements for Fattening Swine. [Cottonseed Meal, Linseed Oil Meal, Peanut Meal, Velvet Bean Meal, Gluten Meal, and Ground Soy Bean Seed compared with Tankage.] (15 pp.) Fayetteville, 1925. [63.64.043.]

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NOTES FOR THE MONTH

Sheep Dipping

A CIRCULAR letter, dated July 14, 1926, to Local Authorities in Great Britain for the purposes of the Diseases of Animals Acts, sets forth the future policy decided upon by the Ministry in dealing with the question of sheep scab.

Mr. Guinness has now been placed in possession of the views of all the bodies consulted with regard to the proposals contained in the draft General Double Dipping Order, and these have been of great value in assisting him to arrive at a decision with respect to future policy. It is clear therefrom that a policy of general compulsory double dipping throughout the country is not acceptable to sheep-owners in a large part of England and Wales nor to the greater part of Scotland.

The proposals embodied in the draft General Double Dipping Order, if applied, would not therefore receive that whole-hearted co-operation from sheep-owners themselves without which any measures for the eradication or control of sheep scab would be abortive. This being so, Mr. Guinness has decided not to proceed further with those proposals, at any rate until there is a general demand on the part of agriculturists as a whole for the adoption of such a course. It is, nevertheless, his wish to meet, so far as it is possible to do so by means of legislative measures, the views of those who desire to see the eradication of sheep scab. It cannot be too strongly emphasised, however, that this object is largely in the hands of sheep-owners themselves, and that no matter what measures may be laid down by Orders of the Ministry or regulations of Local Authorities, success depends in the main upon the willing co-operation of sheep-owners, both to carry out these measures thoroughly and efficiently, and to take all reasonable precautions against the introduction of the disease from elsewhere.

The efforts of the Ministry will therefore be directed principally to the improvement of the existing methods of

dealing with outbreaks of scab on individual premises and in infected areas. The procedure will continue to be that laid down in the Sheep Scab Order of 1920, the Sheep Scab (Amendment) Order of 1923, the Sheep Scab Order of 1914, and the Sheep (Double Dipping) Order of 1920, subject to certain necessary amendments which the Ministry is preparing for application during the next sheep scab season. An endeavour will be made, however, to limit the extent of the double dipping areas declared by the Ministry as far as possible having regard to the actual locality of the outbreaks, and, in defining double dipping areas, to adopt natural boundaries where the advantage of so doing is apparent. The Ministry will also, particularly when the work connected with foot-and-mouth disease permits, endeavour to assist Local Authorities in securing the efficient enforcement of the dipping orders in double dipping areas by detailing members of its veterinary staff for this purpose.

The circular letter (Diseases of Animals Branch Circular Letter, No. 50) may be obtained from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, price 1d. net.

Prices and Supplies of Agricultural Produce and Requirements in 1925-26

THE Ministry's Annual Report on the prices and supplies of agricultural produce and requirements in 1925-26 was issued last month. The price movements of the different commodities during 1925 are reviewed in the Report, and, by means of index numbers, prices are compared over a number of years. The Report shows that the increase in the prices of agricultural produce which took place in the autumn of 1924 and the spring of 1925 has not been maintained. During the seven months September, 1925, to March, 1926, the general level of the prices of agricultural produce had fallen to 55 per cent. above pre-war as compared with 65 per cent. in the corresponding months a year earlier. The sharpest reductions in prices were in barley, potatoes and fat sheep, whereas fat pigs recorded a sharp increase. Prices of feeding stuffs were much lower during last autumn and winter than in the seven months from September to March, 1924-25, the average of the prices being only 34 per cent. above 1911-13 against 64 per cent. a year earlier. All feeding stuffs shared in the decline, the fall being a reflection of the abundant world crops, chiefly of maize, barley

and linseed, which in their turn exercised a depressing effect on the prices of all other feeding stuffs. Fertilisers showed a small reduction, being, relatively, very cheap at only 12 per cent. above pre-war. References are also made in the Report to the wages of agricultural workers, and to the prices of agricultural seeds.

Tables are appended giving the monthly average prices of most agricultural commodities during 1925, the number of animals weighed at certain markets in England and Wales, the imports of live stock into Great Britain from Ireland in each of the last eleven years, and the imports into the United Kingdom of all the chief classes of agricultural commodities during the last six years.

The Report, which forms Part III of the Agricultural Statistics, 1925, may be purchased through any bookseller or direct from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, price 1s. 6d. net or 1s. 7d. post free.

Weighing of Fat Cattle at Auction Marts

THE Markets and Fairs (Weighing of Cattle) Act, which received the Royal Assent on July 15, and which comes into force on January 1 next, makes it compulsory for all fat cattle offered for sale by auction in markets or marts in or near which a weighing machine is provided for the purpose of complying with the provisions of the Markets and Fairs (Weighing of Cattle) Acts, 1887 and 1891, to be weighed before sale. The weight of each fat beast must be disclosed to intending purchasers at the time of the sale either by announcement made by the auctioneer or in some other manner calculated to bring it to their notice.

The Minister of Agriculture is given power to grant exemptions from the provision of weighing facilities where the circumstances are in his opinion such as to render the enforcement of the provision of a weighing machine inexpedient.

Any auctioneer, therefore, who offers for sale in a market or mart after the end of this year any fat cattle unless their weights have been made available to intending purchasers at the time of the sale will be liable to the penalties set out in the Act, unless an exemption has been obtained from the Minister. Any auctioneer contravening the Act will be liable on summary conviction to a fine not exceeding 40s. for each head of fat cattle offered for sale.

Weed Destruction in Autumn

DURING the period of the great war the available labour did not suffice for the usual cleaning of the land, while the practice, necessary at that time, of increasing the number of cereal crops tended to enhance the difficulty of weed destruction. In consequence, many farms became very dirty, and heavy clays in particular have needed a long time to bring them into better condition in this respect. The usual spring cleaning, surface cultivations, hoeing of root crops, and bare fallowing all have their uses, but at this season it may not be amiss to direct renewed attention to the importance of autumn cultivation directly the cereal crops are off the land. Much corn land may be cleared by mid-August; between that date and the end of September there is ample opportunity for weeds in considerable variety to become established. Not only will annuals then quickly ripen and shed their seeds, but seeds of such perennials as creeping thistle, couch, docks, perennial sow thistle and bindweed may germinate and grow strongly enough to reappear if ploughed down in the usual way.

Referring to the value of late hoeing when, for some reason, early hoeing has, presumably, been neglected, it is stated in *The Complete Grazier* (1908, p. 851) that "were the hoe used in the root crops later in the year—in the autumn—seedling docks and seedling couch, which become established after that time, would have little chance of causing trouble." This view may safely be applied to the treatment of stubbles after harvest, when the undercutting of all growth three inches or so below the surface, rather than formal ploughing, may be expected to lead to the destruction of many perennial weeds, while weed seeds are induced to germinate when this shallow layer is stirred and the seedlings are destroyed at the next ploughing. At p. 393 of this issue will be found an article by Mr. Arthur Amos, who deals lucidly with the question of stubble or autumn cleaning. It is true that farms differ widely in their needs, but everywhere it is needful to destroy weeds, and there should be no hesitation in introducing a new implement—be it the Kent "broadshare" or special design for "tractor-broadsharing"—if it will serve the desired end. The proposed stubble cleaning demonstration at the Cambridge University Farm ought to be attended by a big gathering of farmers.

Group Settlements in Western Australia

THE Report on Group Settlements in Western Australia (Cmd. 2673, price 6d. net), issued by the Stationery Office, is written by Mr. W. Bankes Amery, C.B.E., the British Government Representative for Migration in Australia, who visited a number of group settlements in company with members of the Imperial Press Conference towards the end of 1925.

The principle of the group settlements is that several families from the same town or county are selected for settlement on adjoining blocks of land, in the expectation that their common associations will afford a bond of union and prove an antidote to the isolation and loneliness of life in the bush. Thus, there is the Leeds Group, the Devon Group, the Cornwall Group, etc.

At the outset, the work of clearing the land is undertaken by the group working together under the direction of foremen, holdings being allotted individually as the land is cleared. Payment is made for sustenance whilst the work of clearing is in process, but this has not been found satisfactory. Families are provided with shacks pending the erection of permanent cottages on their holdings. Up to date about 1,600 cottages have been provided for 2,273 settlers. The farms cost not less than £1,500 with stock and equipment, but it is provided, under an Agreement dated February 9, 1923, that no settler should be charged more than £1,000. Interest on the farm-costs is being added at 6¼ per cent. It is proposed eventually to charge interest for ten years and subsequently instalments of both capital and interest. About 32,000 acres are under crop, the soil is very fertile and the country exceedingly beautiful.

A distinctive feature of the scheme is that only families with at least three children are admitted. There are at present 1,666 British families, of whom 1,290 were assisted under the Empire Settlement Act, 1922. Among settlers interviewed by Mr. Amery were policemen from London and Leeds, a bricklayer, a baker, two cabinet makers, a lifeguardsman, an artilleryman, a Royal Navy officer, a piano maker, a Government explosives inspector, a signwriter, several engineers, a gas inspector, a chauffeur, several butchers, a railway detective, a laboratory assistant, a greengrocer, several sailors, a printer's assistant, a railway fireman, a professional footballer, a platelayer, two legal clerks, a dock labourer, a grocer's assistant, an insurance broker, an insurance clerk, a painter, a crane driver, and a motor-body builder.

When the initial stages of the scheme are completed and the settlers are left to their own resources, it will be necessary to make provision for the disposal of their produce, and the authorities are fully alive to this fact. At present an outlet is provided by the new immigrants who are constantly arriving and whose land does not immediately come into production.

The proportion of settlers who have left or been dismissed is rather large, averaging nearly 40 per cent. Curiously enough the proportion is higher among Australian settlers than among British, but this may be due to some extent to the greater facilities open to Australians to obtain alternative employment. It is expected that, as the scheme progresses, the proportion of failures will be considerably smaller.

The report lays emphasis on the importance of selecting settlers who are temperamentally suited to the comparative isolation of bush life. The Secretary for Dominion Affairs, in a brief foreword, expresses the opinion that this is one of the most remarkable experiments in the history of colonisation.

Drainage and Mining Around Doncaster: Appointment of Commission

THE Minister of Agriculture and Fisheries announced on July 2 that, whereas it has been resolved by both Houses of Parliament that it is expedient that a tribunal be established for inquiring into a matter of urgent public importance, that is to say, into the conditions in regard to mining and drainage in an area around the borough of Doncaster, the Right Honourable Sir William Joynson-Hicks, Baronet, one of his Majesty's Principal Secretaries of State, has, at the Minister's request, appointed :—

Sir H. C. Monro, K.C.B., late Permanent Secretary of the Local Government Board (*Chairman*);

Mr. W. J. Board, O.B.E., Town Clerk of Nottingham (representing the Ministry of Health);

Mr. I. Burns (representing the Miners' Federation);

Mr. R. Clive (representing the Mining Association);

Sir W. H. Ellis, G.B.E., D.Eng. (President of and representing the Institution of Civil Engineers);

Major F. H. Fawkes, J.P. (Chairman of the West Riding Agricultural Committee, and representing the Ministry of Agriculture and Fisheries);

Mr. T. S. Hawkins, M.B.E., M.Inst.C.E. (representing the Ministry of Transport); and

Mr. A. R. Thomlinson, M.I.Min.E. (representing the Mineral Owners' Association);

to be a Commission to inquire into what is known as the Doncaster Area, with regard to

(1) The effect of the working of minerals on the existing system of land drainage;
(2) The efficiency of the existing system of land drainage, quite apart from the effect thereon of the working of minerals;
(3) the best method of reconciling and co-ordinating such interests as mineral working, agriculture, building, inland navigation and transport generally, etc., in the development of the area;
(4) any related matter;

and to make recommendations on them.

The Commission will have at their disposal the services of Mr. W. J. E. Binnie, M.A., M.Inst.C.E., F.G.S., and Dr. H. Lapworth, D.Sc., M.Inst.C.E., M.Cons.E., as engineers.

Mr. H. Meadows and Mr. J. T. Scurlock, both of the Ministry of Agriculture and Fisheries, have been appointed as Secretary and Assistant Secretary respectively to the Commission, and all communications should be addressed to the former at the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

In virtue of Section 1 of the Tribunals of Enquiry (Evidence) Act, 1921, it has been declared that that Act shall apply to the Commission and that the said Commission is therefore constituted as a Tribunal within the meaning of the said Section of the said Act.

Egg Marketing Reform

AT a general meeting of the West of England Egg and Poultry Merchants' Association, held at Taunton on July 3, 1926, the following resolution and proposals were unanimously adopted and forwarded to the Ministry of Agriculture for consideration:—

Resolution.—That, having regard to the fact that the efforts of this Association to secure adequate and proper reform in the marketing of English eggs in the Association's district have only been partially successful, the magnitude of the task from a national point of view is such that the Association feels justified in petitioning H.M. Government to standardise such reform throughout the country by suitable legislation.

That the Ministry of Agriculture is assured of this Association's co-operation and support in the drafting of the provisions of a Bill, and in view of the serious state of affairs which confronts the home trade, as revealed by the recent publication of a report on "The Marketing of Eggs in England and Wales,"* hopes the matter will receive the Government's immediate urgent attention.

* Economic Series No. 10. H.M. Stationery Office. Price 1/6 net.

Proposals

(1) Every person who is a wholesale dealer or auctioneer of eggs shall be licensed annually.
(2) The licence fees shall not be less than four guineas per annum.
(3) Licences shall be issued by County Councils, or alternatively, by a central authority
(4) There shall be an Egg Marketing Inspector appointed to every area as defined by the Ministry of Agriculture.
(5) The licence fees shall be used entirely as a contribution to the salary of the Marketing Inspector.
(6) The Marketing Inspector shall have power to examine licences, inspect dealers' premises, and report as to their proper conduct of business, with full powers to condemn supplies offered for sale privately or in a public market as unfit for human consumption, and submit a case to his responsible authority for action.
(7) It shall be an offence for any producer or licensed trader to offer for sale any eggs which are in a dirty condition, stained, stale, bad, or in any way contaminated.
(8) Only two classes of English eggs should be recognised: guaranteed new laid, and second grade. The foregoing applies to internal quality
(9) All eggs shall be purchased by weight value only.
(10) Every licensed trader shall sell eggs by graded weight to be determined later
(11) Each case of eggs marketed shall have attached to it a label stating the grade
(12) Any licensed trader offering for sale eggs which do not comply with the guaranteed weight, shall be liable to prosecution, and the forfeiture of his trading licence (with adequate safeguards)
(13) Every instance where these regulations have not been observed shall be reported to the Marketing Inspector Traders not reporting delinquencies shall be held responsible equally with the producer for endeavouring to evade the regulations

Whatever the merits of these proposals—and they will, of course, be carefully considered in common with other proposals that have been or may be put forward—then adoption by west country egg merchants is an event of great importance, and suggests a progressive and enterprising outlook on marketing problems. It will be recalled that arising out of the National Conference on Egg Marketing, which took place in London last January, the National Farmers' Union and the National Poultry Council agreed to collaborate with a view to drafting proposals. As a preliminary, the National Farmers' Union has taken steps to ascertain the views of its county branches. The above proposals will add to the interest with which the outcome of the deliberations of these representative bodies is being awaited.

STUBBLE OR AUTUMN CLEANING

ARTHUR AMOS, M.A.,
Director of the University Farm, Cambridge.

IT is now frequently stated that the four-course or Norfolk rotation, which has formed the basis of arable farming in the Eastern counties since the middle of the eighteenth century, no longer provides the key to successful farming. This rotation entails too much manual labour for the management of the root crop, which yields too small a return. Nevertheless, so long as labour was cheap it served two most important functions: (1) it enabled the land to be kept clean, and (2) by providing food for stock enabled the fertility to be maintained.

Farmers are quite rightly breaking away from this system in order to reduce their expenditure on wages, but in all too many cases this results in the multiplication of weeds on the arable fields. How can this be avoided? In a few cases the root crop is being substituted by the bare fallow followed by a crop of mustard to be ploughed in as green manure. This enables weeds to be kept down, but it lowers the production of the farm and can hardly be justified on light or medium land. In some cases silage crops are being introduced, and these not only prevent weed growth and weed seed formation but contribute to the accumulation of fertility. They do not, however, by themselves provide much opportunity for the germination and subsequent destruction of weed seeds already in the soil.

The purpose of this article is to draw attention to the possibilities of stubble cleaning, the importance of which has always been recognised by good farmers under any system, and particularly in certain districts. Thus the Kent farmer with his long-cherished wooden plough, for which he has been the recipient of much ridicule, converts this same wooden plough into a broadshare as soon as his corn is cut, and with this ancient implement proceeds to "broadshare" or "spuddle" his stubbles. Incidentally, no implement with which the writer is familiar can compare with it in efficiency for this work. In the middle of last century Bentall and others designed broadshares to execute similar work, and quite efficient implements they proved (in fact, one of them is still annually brought into play on the University Farm at Cambridge), but they were generally heavy in draught and were considered to be "horse killers."

With the introduction of tractors, which exercise their power to the best advantage after harvest when the land is dry and the going is good, this objection to the broadshare vanishes, and a few implement makers have attempted to design suitable implements for "tractor-broadsharing." Nevertheless, these new tractor implements have not "caught on" and are only occasionally seen on farms. Whether this is due to faulty design, or whether their good points have not been sufficiently brought home to farmers, it is not necessary to discuss here, but in order that a lead may be given and an agricultural searchlight brought to play upon the subject, the Agricultural Education Committee of the Cambridgeshire County Council and the Cambridge University Farm have decided jointly to hold a stubble cleaning demonstration, mainly for tractor-drawn implements, on the University Farm on Wednesday, September 15, to which all interested are welcome.

Advantage of Stubble Cleaning.—At this point it may be well to consider why such emphasis has been laid upon stubble cleaning. The answer is that the autumn is the best time of year for killing weeds on corn land for the following reasons :—

(*i*) The weeds are at their weakest after the corn is cut. During the summer they have been growing in competition with a tall cereal crop which, if a good plant, has taken the greater part of the available moisture and plant food from the soil, and light and air from their foliage. Moreover, the weeds have been cut off by the binder which cuts the corn and have been weakened by this cutting.

(*ii*) If the stubble is not quickly cultivated, the weeds commence active growth, nourished by all the soil moisture and plant food which may then be available, and all the sunlight and air, unhindered by any crop. Annual weeds rapidly mature their seeds, and perennial weeds such as the thistle, the dock, and couch break into active growth and proceed to store up in their capacious roots or underground stems the plant food which shall give them vigorous growth in the following spring. *It is much too frequently overlooked that perennial thistles and other perennial weeds spend the first part of the year exhausting themselves by trying to flower and to reproduce themselves, and spend the second part of the year building up a store of food for the next year's growth.* If the second stage can be prevented the growth in the following year will be weak.

Fig. 1. Showing the Work done by a Kent Broadshare.
Note the shallow Ridges.

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(*iii*) At this period of the year the land is generally dry, partly as a result of the weather, and partly because the roots of the crop have dried the land, and therefore the weeds can be dried out more easily.

(*iv*) Time can generally be made available after harvest (or between the rows of shocks during a wet spell in harvest) to proceed with the work, more particularly when a tractor is available.

(*v*) There is no growing crop to interfere with the work

The Ideal Method consists of undercutting the stubble at a depth of 3 in. to 4 in. This depth is selected because at this period of the year the underground stems of couch and twitch are shallow. The operation requires to be done without breaking the stems of the couch, because such breaking results in a multiplication of small plants. Hence a broadshare is preferable to a narrow cultivator tine. A plough is generally not a good implement for the purpose, since it inverts and buries the weeds which must subsequently be worked out; but on the other hand, the undercut stubble must not be allowed to drop back into its original position, since a light shower of rain would quickly set the weeds again. The photographic illustration shows a field left in loose ridges as done by a Kent "broadshare." The soil and weeds in these ridges quickly dry out, and the weeds can then be quickly separated and collected. The same broad blade of the broadshare is also an ideal weapon with which to cut the vertical stems of thistle, bindweed, etc., so that these are prevented from making any effective growth till the following spring. Lastly, the same tillage implements ærate and break down the surface three inches, so that as soon as rain falls all weed seeds lying dormant in this layer are given ideal conditions for germination, so that the seedlings can subsequently be easily destroyed in the course of the autumn or winter ploughing for the next crop.

It is certain that no one implement will prove ideal under all conditions, but at present it seems to the writer that there is not a sufficient selection for the keen farmer who wants to exterminate weeds by stubble cleaning: hence the demonstration which is about to be held.

ELECTRICITY IN AGRICULTURE

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IN recent years there has been much discussion about the application of electric power to agriculture, especially since the introduction of the Government's Electricity Bill.

It is, perhaps, difficult to hold a safe course between the rock of conservatism of the old-fashioned farmer, who regards the idea of electric power as a new-fangled nostrum, useless to the practical man, and the whirlpool of enthusiasm of those who expect the countryside to be covered at once with a network of electric mains, and hear the coming of the salvation of agriculture in the sound of that blessed word Electricity. Let us try to steer between Scylla and Charybdis.

In taking an impartial survey, we will consider, first, what electric current, if available, can do on a farm; and, secondly, the methods of obtaining it—the chances of getting a public supply in rural areas, and any alternative methods of producing electric current that are possible.

Farm Uses of Electricity: *Lighting.*—The effectiveness, convenience and cleanliness of electric light are as important in a farm-house or labourer's cottage as in a town dwelling, and in farm buildings, such as barns and cowhouses, good light leads to work being carried on more easily, efficiently and sometimes for longer hours, thus bringing an appreciable saving in labour. The necessary wiring need not be very elaborate; outdoor bare wires on porcelain insulators will go a long way, and an allowance of about £1 per point should cover the cost of fixing.

Where many fowls are kept, electric light is especially useful. It can be turned on, automatically if desired, in the fowl houses on winter evenings, and the birds given an extra feed. Though the total production of eggs is not much affected, the number of those laid in winter when eggs are dear is increased at the expense of summer ones, and the financial results are much improved.

Heating.—In some countries, where water-power is cheap and coal and wood are dear or unobtainable, electric heating and cooking are being used in farm-houses. In England, the only probable domestic use of electric heating is for special appliances such as laundry irons, but for poultry farming

electric incubators have distinct advantages, the temperature and ventilation in them being very well controlled.

Experiments are being made on the effect of heating silage by an electric current. Above 47° Centigrade (117° Fahrenheit) the acetic and butyric acid bacteria, which produce sour silage, are suppressed, and those producing lactic acid and giving sweet silage alone survive. The necessary heat can be obtained spontaneously by skilful manipulation of the crop and whether the possible greater certainty of electric heating repays the extra cost remains to be seen.

Power for Stationary Machines.—Where a public electric supply is laid on, a farmer can obviously use electric motors for all purposes for which he now generally works an oil engine. The electric motor is convenient, robust, small in bulk, and can be started by turning a handle. Chaff-cutting, root-pulping, water-pumping, etc., can be done with a motor of 3 to 5 horse-power, and, with the usual charges for electric power of 1d. to 3d. a unit, can be carried on cheaply. Thrashing, heavy grinding and sawing need more power, and, except on very large farms, where much of such work is done, difficulties arise. The cost of the motors will be high for apparatus used only at intervals; and occasional heavy loads, which mean bigger mains than can be kept steadily employed, are very unprofitable to the supply companies.

Yet electric motors have great advantages. They can be made very effective in quite small sizes, as we realise painfully in the dentist's chair. Machines such as horse-clippers, dairy appliances like separators and butter churns, or the ventilating fans of incubators—things all too small to make it worth running an engine—can be driven easily and conveniently by electric motors of fractional horse-power.

Again, a reciprocating engine, which works with cylinders and pistons, does its work by a series of impulses. The explosions of oil spray or petrol vapour and air give an irregular pull on the driving belt. The electro-magnetic force in an electric motor, however, is practically continuous, and consequently the pull is steady. This is said to give an improved yield of corn of anything up to 5 per cent. when thrashing, and is also important in driving milking machines where a steady vacuum is desirable.

There is no doubt that this steadiness is of considerable advantage in some types of machinery, while the number of light-work operations, in which small motors are specially

useful, is extending and is likely to extend rapidly. It is in these latter operations that the special advantage of electric power to the farmer is likely to be found.

Power for Field Cultivations.—Much the greater part of the power used in agriculture goes in transport or field cultivation —in the latter alone, perhaps three times the power consumed by barn machinery. The ordinary farmer uses horses for both transport and cultivation, and, we may safely prophesy, will continue to do so. At all events, until a cheap and light storage battery is invented, electric haulage has no chance against horse-drawn waggons and steam or petrol lorries.

Some advance has been made in applying electric power to field cultivation. In Italy, Germany and France, ploughing sets have been described as in use by contractors, who plough on terms similar to those offered by the owners of steam-ploughs in East Anglia. I only know of one set at work in England—a private one on the farm of Mr. Borlase Matthews near East Grinstead ; and one in Scotland worked by Major McDowall. Mr. Matthews' plough is hauled by a steel wire rope, and Major McDowall's is attached to an electric tractor supplied with current through an insulated cable unwound as the tractor moves one way, and wound up as it comes back.

On the Continent, the contractor's plant is said to consist usually of a double-winding set like our familiar steam ploughs. The motor-waggons are very heavy, and descriptions of the large tractors, or teams of several horses, needed to pull them about are not encouraging. The practical farmer will feel that it would probably be better at present to let the tractors or horses do the job themselves, and save the considerable expense and appreciable danger of carrying live wires into each field on a farm.

Unless some great improvement is made, I do not think that electric ploughs can compete successfully with horses on the ordinary mixed farm ; or where, in arable country, fields are large and flat, with steam or oil-engine ploughs on heavy land, and tractors where the soil is light. The truth is that the English farm of moderate size must employ motive power which, like horses everywhere, and possibly tractors in special places, can be used for all the many jobs a farmer must plan out day by day and week by week.

Moreover, the amount of artificial power used on a farm is comparatively small. The machinery in a factory has to be driven wholly by mechanical power, and no other method of

conveying and applying power at one place is so convenient as an electric current. Hence comes the great growth in consumption of electric energy in industrial areas. As against this it may be said that the energy needed by growing crops is obtained from sunlight. The work of the farmer is merely to prepare the soil and the plant to use a small fraction of this vast flood of free natural power—which may sometimes amount to more than a thousand horse-power an acre—and to carry away the proceeds for the use of man or beast. A farmer's main power station is the Sun.

Specific Effects of Electricity on Cultivation.—Several investigations have been made on supposed specific effects of electricity on crops and farm operations. The only one which yet gives much promise of usefulness is the stimulation of growing crops by a high tension electric discharge.

This surprising phenomenon seems well established. If a network of overhead wires be electrified, the crops growing beneath are affected, usually beneficially. Experiments are beginning to show that the full effect can be obtained by exposure to the electric field for a short time in the early stages of growth. If it proves that the good effect can be obtained by a quite temporary application, the process may some day be of use to the market gardener and just possibly to the arable farmer; but the subject is still in an early experimental stage.

Electric Supply: *Public Power Stations.*—What has been said is enough to show that, if a farmer can get electric current laid on to his house and buildings, he will do well to use it for both light and power. In the neighbourhood of towns, and in industrial areas like South Wales and the North East coast, electric supply can already be obtained, and is used on many farms. How far is it reasonable to hope that it will gradually be extended into rural neighbourhoods?

The problem is clearly one of demand. Will the present rural demand for light and power make it profitable for a company or Local Authority to run mains about the countryside, or, if not, will future prospects be better than present ones?

We may fairly expect that most farm-houses would instal electric light, and experience shows that on an average somewhere about 200 units (kilowatt hours) would be used per

annum for each farm-house and buildings, and a few more to light the dependent cottages and heat an occasional laundry iron.

An estimate of the probable consumption of power for ordinary barn machinery can be made from the number of hours the oil engine is in use at present on typical farms. I found it to vary roughly with the size of the farm and with the proportion of arable land, ranging from less than the equivalent of 1 electric unit per acre for a Dorsetshire grass farm to 11 units for a Cambridgeshire farm with 75 per cent. of its area under the plough. Deducting something for small holdings, this led to an estimate for light, heat and power of 1,600 to 6,000 units per annum for each square mile of country. Of the few instances where current is now used, I got particulars in five cases, and found the actual consumption to vary from 1,000 to 6,800 units per square mile. This conformity with the previous estimate gives some evidence that these figures are of the right order of magnitude. They take no account of possible future developments. For instance, if field cultivation were carried out by electric power, in arable countries at least 12,000 units per square mile would be consumed each year in ploughing, and, perhaps, half as much again in other operations. At present, however, a consumption of about 6,000 units per square mile probably represents the maximum on the average in rural areas with existing farm practice, though doubtless higher (and lower) individual instances could be found.

Now, to electric supply engineers these figures will seem very small; in towns, the consumption per square mile may be a hundred times as much. It is not likely at present that local authorities or supply companies will erect over the countryside a network of mains like those in towns.

But rural population is not spread uniformly. Chains of villages tend to follow a valley, a river or a road, and along these lines I estimate that electric mains will in some places pay their cost at once, especially where a high proportion of arable land indicates an appreciable agricultural demand for power to drive barn machinery. When schemes for electric supply are under consideration, it is to secure such practicable developments as these that landowners and farmers should exert their influence. To clamour for " complete and immediate rural electrification " will defeat its own object. Let us ask for what is reasonable.

One caution must be given. To carry electric power long distances, high tension currents, running to tens of thousands

of volts, must be employed. These currents are dangerous, and must be transformed down to at most a few hundred volts before being used. Transformers are costly, and no farm of moderate size consumes enough energy to pay for such a transformer. Hence, even if high tension mains run right through his fields, a farmer may not be able to tap them. It may actually be cheaper to instal a private electric generating plant. Only where a good-sized village, or some power-using rural industry exists, can a high tension transformer pay for itself.

On the other hand, the promoters of schemes of electrification should not forget that a line which does not pay at once may, by its very presence, favour the development of new industries, and thus, if erected in the right place, lead to a profitable load. This is the experience of France and other countries which have gone faster than Britain in carrying electric supply into country districts. Again, the high standard required in the installation of electric mains in Great Britain increases the cost compared with that in other countries. Cheaper work, consistent with safety, might be allowed and would tend to hasten electric development.

Village Power Stations.—Where no supply is available from a large power station, an enterprising village can well supply itself. Several village stations are already at work, mostly with satisfactory financial results. Few of them, like Llannwchllyn in North Wales, are fortunate enough to have a stream of water with a fall of 70 feet, but lower falls are used at Greenlaw in Berwickshire, and Kintbury in Berkshire, where water power is now supplemented by an oil-engine. Wedmore in Somerset uses suction-gas engines, and Hexton in Hertfordshire relies on two oil-engines. At Llannwchllyn, where water is plentiful, the dynamos run continuously night and day, and the power is correspondingly cheap. At all the other places named the energy is stored in batteries, and costs are higher, even where labour is reduced to a minimum by making the plant automatic. In nearly every case for which I could get figures, the station runs at a profit.

Private Installations.—How far should an isolated farmer be encouraged to set up an electric plant of his own? If he merely wants to work the usual barn machinery—chaff cutter, root pulper, saw bench, etc.—he may just as well drive direct from an oil-engine and not bother himself about electricity. Oil-engines are cheap, and do not eat their heads off when not

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at work. Hence they are specially suited to the intermittent load of the ordinary farm.

If, on the other hand, a farmer cares for good light, a small electric installation, consisting of prime-mover, dynamo and storage battery, will supply it at a reasonable cost. If a stream with a fall of a few feet is at hand, the dynamo can be driven by water power ; in exposed places a windmill may be used ; but generally a small oil-engine will be found the best prime-mover. A half or three-quarter kilowatt plant, at about £100 (or less if the farmer already has a suitable oil-engine), will light a small farm-house and buildings. A moderate increase in size and cost will enable the owner to run, by electric current, light machinery, such as a milking machine, a separator or an incubator. I think that is as far as the ordinary farmer should go at first. Unless public supply is available, heavy work is better done directly with an oil-engine.

On a very large farm, or group of farms, worked by an owner with engineering interests and experience, possibly a plant on a larger scale may be worth consideration—but each such case must be dealt with on its merits, and expert advice be sought. The modest scheme suggested in the last paragraph is one that anybody may adopt. He will gain the benefit of good light and be able to run conveniently the small machines for which electric power has special advantages. He will be able, too, to take advantage of new inventions as they appear, without waiting for public supply to come to his doors.

NOTE.—Further information may be found in the following book and papers : A. H. Allen, "Electricity in Agriculture," 1922 ; R. Borlase Matthews, *Jour. Inst. Electrical Engineers*, 1922 and 1926 ; Report of a Committee of the Institute of Electrical Engineers, August, 1925 ; C. Dampier Whetham, *Jour. Roy. Agric. Soc.*, 1924. A monthly journal is now published, entitled *Electro-Farming*.

LAMB PRODUCTION FROM GRASS FLOCKS

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Introductory.—Sheep kept solely on grass are, to-day, found in increasing numbers in most counties in England; in fact, the small grass flock has, during the past few years, been a profitable sideline. In the south these flocks are usually kept for the production of fat lambs, and no attempt is made to maintain the flock numbers by breeding. The common practice is to procure a number of gimmers or ewes and to retain them for the length of their useful life, purchasing further breeding stock from outside sources as required. This custom has the merit of spreading the difference between buying-in and selling-out prices over a number of years. It is also advantageous that ewes, used for this purpose, should be reared on their native pastures, thus ensuring trueness to type and constitutional vigour. Such ewes coming, as they usually do, from rough grazings on hill or mountain to the more fertile lowlands, normally do exceedingly well.

The prospective flock master has two important selections to make, (1) the breed of ewe most likely to suit his particular set of condition, and (2) the breed of ram to mate with the ewes. So far as ewes are concerned, if extensive inquiries are made a decision will be very difficult to reach, as strongly recommended breeds are numerous. If the practice of neighbours is examined, even then a reasoned decision may be difficult. Taking the county of Herts as an example, the breeds of grass sheep (and standard crosses) to be found include Scotch Half-Bred, Scotch Grey Faces, Yorkshire Masham, Border Leicester, Cheviot, Blackface, Dorset Horn, Clun Forest, Exmoor, Ryeland, Kent, Kerry Hill, South Devon and Western. Which out of this formidable list are to be regarded as the best breeds for the conditions prevailing in Hertfordshire? The north-country farmers usually select the breeds with which they are most familiar; the farmers from the west make a different choice; other farmers may be influenced mainly by the question of price. Yet, while it may be impossible to arrange these breeds in order of merit, it is reasonable to suppose that some are more suitable for the county than others.

Turning now to the second consideration, the ram, the choice is not so wide. A first cross is almost always favoured and usually the Suffolk is chosen as the sire. However, the Border,

Leicester, Ryeland, Wiltshire, Hampshire, South Down, Kerry Hill, and Western are among those used, so that the total number of differently bred first-cross lambs produced in the county (with ewes of fourteen breeds mated with rams of at least seven breeds) lies somewhere between fourteen and ninety-eight. A visit to any of the county markets provides the opportunity for a very interesting, if puzzling, study of sheep breeding.

As there is a great dearth of information concerning the relative values of these crosses for fat lamb production, it was decided, when the County Agricultural Institute was started five years ago, to make use of the grass flock maintained here to collect each year some reliable data on this question. Four years' results indicate very clearly the great value of a simple recording investigation of this kind.

Outline of the Scheme.—As grass ewes had to be kept, it was decided to purchase representatives of two breeds in order to provide a comparison under the same conditions of grazing and management. The most common grass breed in Herts is the Scotch Half-Bred, and this breed was, therefore, taken as a standard. A second breed was sought for to meet what appeared to be the special circumstances, namely, extremely poor pasture which was liable to be wet in winter. Previous experience with Ryelands indicated that these sheep had a wonderful faculty for keeping fit on the poorest of grass land, and they were reputed to be very free from foot-rot; so this was the second breed selected. Two years later the grass at the Institute had enormously improved, making it possible to increase the size of the flock by the introduction of a third breed. The "reason" for the choice on this occasion was quite characteristic of the lack of information on the subject; someone said his neighbour had done extraordinarily well with Kerry Hill ewes, so Kerry Hills were obtained.

A decision with regard to the breed of ram with which to cross the ewes presented no difficulty, for, as already stated, the Suffolk is first favourite in the county for this purpose. One variation from this cross, however, occurred in the first year, when the flock was divided into two halves, with Half-Bred and Ryeland ewes in each half and a Ryeland Ram used on one half and a Suffolk on the other.

The scheme of crossing for the past four years has therefore been as follows :—

First Year, 1923—

(1) Ryeland Ram on Ryeland Ewes	..	R	×	R*
(2) Ryeland Ram on Half-Bred Ewes	..	R	×	HB
(3) Suffolk Ram on Ryeland Ewes	..	S	×	R
(4) Suffolk Ram on Half-Bred Ewes	..	S	×	HB

Second Year, 1924—

(1) Suffolk Ram on Ryeland Ewes	..	S	×	R
(2) Suffolk Ram on Half-Bred Ewes	..	S	×	HB

Third Year, 1925—

(1) Suffolk Ram on Ryeland Ewes	..	S	×	R
(2) Suffolk Ram on Half-Bred Ewes	..	S	×	HB
(3) Suffolk Ram on Kerry Hill Ewes	..	S	×	K

Fourth Year, 1926—
As for third year.

Methods of Recording.—The procedure adopted was the very simple one of ear-marking all lambs at birth so that each lamb could be identified at any time. All the live lambs were weighed at birth and at intervals till they were sold to the butcher, who purchased them at an agreed price per stone of 8 lb. dead weight. There were, therefore, no complications in the methods, all that was required being accurate ear-marking and weighing. The flock was managed in every way as a commercial unit, with the exception that it was gathered in more frequently than usual for the purpose of weighing.

Results.—Four years' records have provided a great mass of detailed information on such relative qualities of the various breeds and crosses under investigation, as

(1) Prolificacy of the ewes.
(2) Weight of lambs—singles, twins and triplets—at birth.
(3) Birth-weight production per ewe.
(4) Rate of growth—singles, twins, triplets.
(5) Return in lamb meat per ewe.
(6) Numbers of days to fatten.
(7) Percentage carcass weights.
(8) General financial results.
(9) Sheep and grassland improvement.

Full details of the figures and results obtained will be published later. In this article a summary of the salient practical points only is given.

Grazing Conditions.—The seventy-six acres of grassland utilised by the flock are divided into three fields.

(a) Horse Paddock (11 acres), used for lambing purposes only.
(b) Old Park (47 acres), grazed by cattle and sheep.
(c) New Park (18 acres), grazed by cattle and sheep.

* The abbreviations in this column are used in subsequent tables.

It is apparent, therefore, that there was very limited opportunity for changing the sheep to fresh ground. It really amounted to using two fields alternately.

In the autumn of 1921 and in the summer of 1922, the grass in the Old Park had all the appearance of extreme poverty—the bottom was dry and wiry, while clover plants were extremely difficult to find. This grassland presented a problem, the solution of which was first indicated in the summer of 1922 when some slight results were seen from a series of trial plots with various manures. Arising from this preliminary observation, the whole of the Park was dressed with 6 cwt. per acre of ground mineral phosphate (North African) in the early spring of 1923. Thereafter, further investigations revealed the fact that three factors contributed to the transformation of this poor grass into a comparatively luxuriant herbage of grass and clover. The first essential was efficient grazing, which enabled the next factor, the phosphates, to stimulate the clovers, and finally severe cultivations each spring removed bent and moss. The sheep, therefore, played a very useful rôle in this grassland improvement—an improvement which can be fully appreciated from the accompanying illustrations—and by a consideration of the following figures from the weights of two plots and the botanical analyses of certain portions of the field :—

BOTANICAL ANALYSES OF PASTURE IN 1925

	Inadequately grazed		Well grazed
	No manure	6 cwt. G.M.P.	6 cwt. G.M.P.
Good grasses	·5 per cent.	14 0 per cent	21·0 per cent.
Indifferent grasses ..	64·0 ,,	37 0	30·0 ,,
Clovers	5·0 ,,	14 0	33·0 ,,
Weeds	24·0 ,,	32 0	8·0 ,,
Hay (previous year) ..	7½ cwt.	22·0 cwt.	

From 1924 onwards, this grassland was no longer poor: its stock-carrying capacity had been nearly doubled and the improved quality of the herbage no doubt compensated for the limited changes of ground available for the sheep.

Management of the Flock.—The flock was maintained entirely on the grass, receiving no help from the arable land except a few roots and some silage before and after lambing. Experience has shown that good silage, finely chaffed into the silo, makes a much-relished food for both ewes and lambs. Lambing started each year between the middle and end of

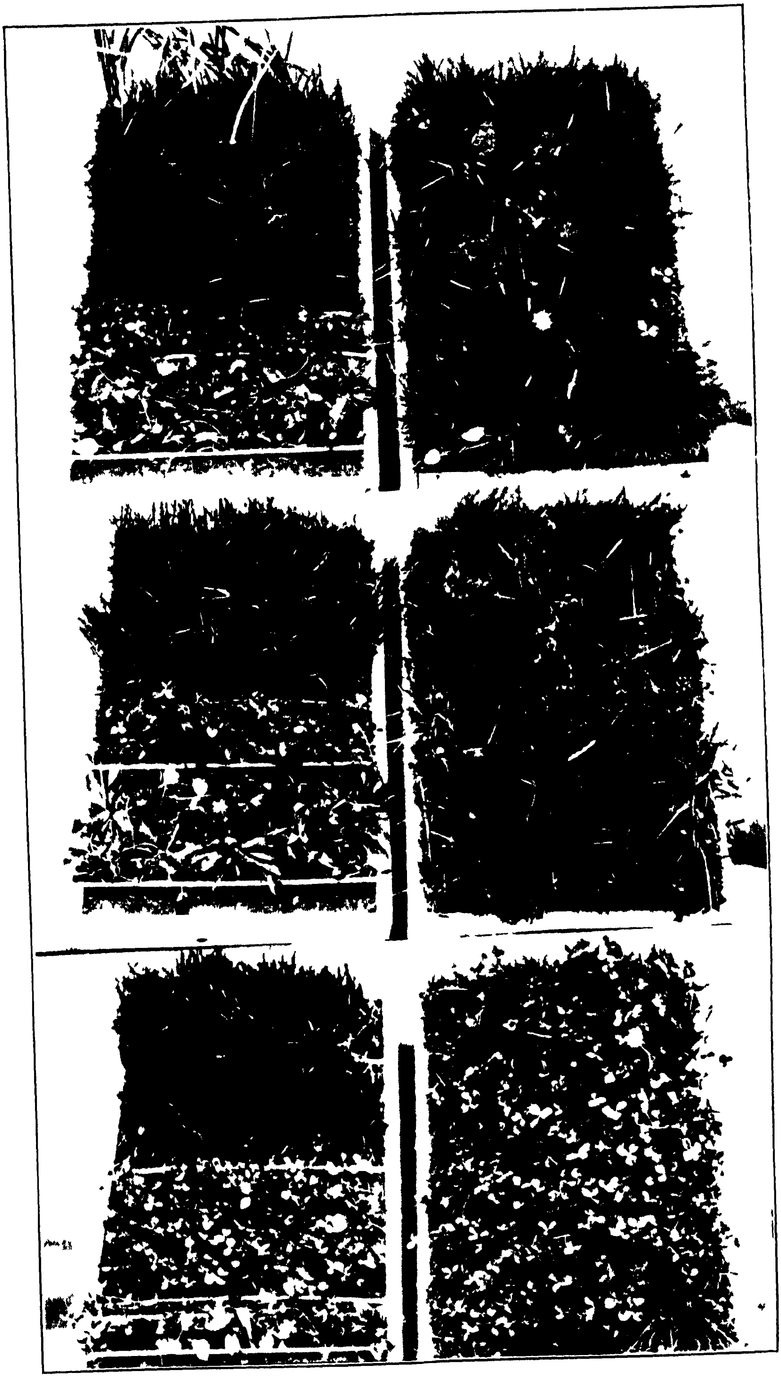

FIG. 1 *Top* Turf from No Manure Plot
Centre Turf from Manured Plot very badly Grazed
Bottom Turf from Park Manured and well Grazed

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February. Towards Christmas, hand feeding of the ewes began —at first about $\frac{1}{4}$ lb. of mixed cake and meal, increasing later and after lambing to $\frac{1}{2}$ lb. per head. With this feeding—silage, a few roots and concentrates—ewes came to the lambing pen in good condition and with plenty of milk according to their qualities in this respect. Lambing took place in an improvised lambing pen with a shepherd's hut close by where students were on duty in rotation. As the young lambs began to feed, a special pen with a lamb creep was erected in the field, where many of the lambs learned to feed by themselves. Later, lambs were drawn out as in ordinary farm practice and sent to the butcher, live and dead weights being recorded.

A summary of the records obtained in the four years can now be given.

Prolificacy.—In estimating the percentage of lambs, use has been made of the following two sets of figures—the number of *live* lambs at birth and the number of ewes that produced them. No account has been taken of barren ewes or any ewes which did not give birth to live lambs. The percentages thus arrived at may not represent the strictly orthodox birth-rate, but on the other hand they give quite accurate comparative results. It has also to be pointed out that serious losses were occasioned, in 1925, by a night attack of dogs on the flock a week or two before lambing commenced. This resulted in the death of two Half-Bred ewes and the arrival of a number of dead lambs. Apart from this year, very few casualties among lambs occurred, as will be seen from later figures.

Based on the method described above, Table I shows the percentage of lambs from each breed.

TABLE I

PERCENTAGE OF LIVE LAMBS

Year	(*a*) R × R	(*b*) R × HB	(*c*) S × R	(*d*) S × HB	(*e*) S × K
1923	150	175	150	162	—
1924	—	—	156	176	—
1925	—	—	144	153	121
1926	—	—	153	195	161
Average	150	175	151	173	144

Still further summarising these results, it is seen that :—

The Ryeland ewes yielded 151 ;

the Half-Bred ewes yielded 173 ;

the Kerry Hill ewes yielded 144.

The Half-Bred ewes have, therefore, shown, on the basis described, a clear superiority over the other two breeds from

the point of view of prolificacy. This result is consistent in each lambing season.

Deaths.—The Ryeland and Half-Bred ewes were originally purchased in the autumn of 1922, and the Kerry Hill ewes in the autumn of 1924. Excluding the two Half-Bred ewes which were killed by stray dogs, deaths occurred as follows :—

Original number of ewes		Breed	1922 to 1924	1924 to 1926	Loss per annum per cent.
30	..	Ryeland	4	4	6·6
30	..	Half-Bred	3	5	6·6
35	..	Kerry Hill	–	4	5·7

From these figures, there would appear to be little to choose between the three breeds. The death rate amounts to 25 per cent. of the whole flock every four years.

Reports from the Lambing Pen.—The period of lambing and the weather conditions were as follows :—

		Lambing commenced	Lambing completed	Weather
1923	..	February 17	March 26	Very wet and cold.
1924	..	February 14	March 24	Cold but fairly dry and occasional sun.
1925	..	February 14	April 17	Very wet and cold.
1926	..	February 18	March 15	Exceptionally fine.

In the four lambing reports (contributed each year from an independent source) the following points are emphasised :—

(1) The condition of the ewes of each breed at lambing time was good.

(2) Actual lambing gave little trouble, though the Half-Bred excelled in this respect.

(3) Half-Breds made good udders and had ample milk at the time of lambing, while Kerry Hills, and especially Ryelands, were slower in this respect.

(4) Half-Bred and Kerry Hill ewes took to their lambs at once, but Ryelands had frequently to be penned in for a few days till the lambs suckled freely or were taught to do so.

(5) Half-Breds and Kerry Hills were excellent mothers and looked after their lambs from the start ; in these respects they were much better than the Ryelands.

Briefly, it seems clear that the Half-Bred ewe, in spite of her more nervous temperament, proved to be the shepherd's favourite, with the Kerry Hill a close second. As a mother, the Ryeland compares unfavourably with either the Half-Bred or the Kerry Hill.

Birth Weights.—Table II below presents a summary of the birth weights of all the live lambs in the flock during the past four years.

TABLE II

WEIGHT OF LAMBS AT BIRTH

(*Average of four Lambing Seasons*)

Breed	Singles		Twins		Triplets		Breed Average	
	No. of lambs	Av. Wt of lambs lb.	No. of lambs	Av Wt of lambs lb.	No. of lambs	Av. Wt of lambs lb.	No. of lambs	Av. Wt. of lambs lb.
R × R ..	2	12·7	7	7·9	—	—	9	8·9
R × HB	3	8·5	18	7·7	—	-	21	7·8
S × R ..	25	11·4	72	8·5	3	7·2	100	9·1
S × HB	21	10·7	96	8·3	16	7·5	133	8·6
S × K ..	28	10·5	39	8·1	8	6·2	75	8·8
Average: all breeds	79	10·8	232	8·3	27	7·1	338	8·8

The average birth weight of all the lambs, 338 in number, is 8·8 lb. The variation from this mean in the case of the pure Ryeland and the various crosses is quite small. Still, the number of Suffolk crosses is sufficient to give significance to small differences, and it would appear that the Ryeland ewes produced on the average the heaviest lambs and the Half-Bred the lightest. Comparing singles, twins, and triplets, the relative weights at birth are most clearly brought out by denoting the average weight of the twins in each breed by 100:—

	Singles	Twins	Triplets
S × R	134	100	85
S × HB	129	100	90
S × K	130	100	77
Average of all breeds..	130	100	85

From Table II it is seen that the relative weights of S × R twins and singles are 8·5 and 11·4 lb ; this ratio is the same as 100 to 134, *i.e.*, Ryeland singles are 34 per cent. heavier than twins.

Production per Ewe.—The average total weight of live lambs produced at birth by each of the breeds under consideration is shown in Table III.

The average production at 213 births is seen to be nearly 14 lb. per ewe. This is a higher percentage of the live weight of the dams than is found with the larger farm animals, amounting as it does to 10 per cent. of the live weight of the ewes

TABLE III

NUMBER OF EWES* AND AVERAGE WEIGHT OF LIVE LAMB PER EWE

(*Average of four Lambing Seasons*)

Breed	Singles		Twins		Triplets		Breed	Average
	No. of ewes	Av. Wt. per ewe lb.	No. of ewes	Av. Wt. per ewe lb.	No of ewes	Av. Wt. per ewe lb.	No. of ewes	Av. Wt. per ewe lb.
R × R	2	12·7	4	13·7	—	—	6	13·4
R × HB	3	8·5	9	15·3	—	—	12	13·6
S × R	25	11·4	39	15·6	2	10·7	66	13·9
S × HB	21	10·7	50	16·0	6	20·0	77	14·9
S × K	28	10·5	21	15·0	3	16·6	52	12·7
Average: all breeds	79	10·8	123	15·6	11	17 4	213	13 9

Differences between the breeds are larger than was found with birth weights owing to the varying birth-rate. The Half-Bred ewe now takes premier place in productive capacity—the smaller weight per lamb being more than counterbalanced by the the greater number of lambs. Putting the productive capacity of ewes with singles at 100, the relative position of the breeds is as follows :—

	Singles	Twins	Triplets
S × K	100	143	94
S × R	100	137	187
S × HB	100	150	158

Further, if the production per ewe from the Kerry Hills is taken as a standard, the relative productive capacity of the three breeds can be reduced to the following ratio :—

S × K	=	100
S × R	=	109
S × HB	=	117

In the production of fat lamb, the Half-Bred therefore leaves the lambing pen with a clear lead of 17 per cent. over the Kerry Hill and 8 per cent. over the Ryeland.

On the basis of the results described, Table IV has been prepared to show the number, nature and weight of live lambs that might be expected from 100 ewes of each breed.

Obviously, the best results are obtained when singles are few in number and twins and triplets are many.

A further interesting point became apparent after the ewes had been weighed. It was then noted that the average weight of

* The number of *live* lambs produced by these ewes is shown in Table II.

singles and twin lambs varied directly in proportion to the weight of the ewes, but that the production per ewe bore no

TABLE IV

LAMBING PROSPECTS

	No.of Singles	Wt. lb.	No.of twins	Wt. lb.	No.of trip-lets	Wt. lb.	Total weight of lamb from 100 ewes lb.
100 S × R	38	433	109	928	4	29	1,390
100 S × HB	27	289	125	1,043	21	158	1,490
100 S × K	54	569	75	607	15	94	1,270

such ratio. Thus although the smallest ewe—the Kerry—had the smallest single and twin lambs, it is the Half-Bred, intermediate in weight between the other two breeds and with the smallest average weight per lamb, which was the most productive.

WHALE MEAT PRODUCTS AS FOOD FOR PIGS

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RECENT research in animal nutrition has directed attention to two factors of very considerable importance in the feeding of farm animals. These are (1) the necessity for providing the young and quickly growing animal with an adequate supply of bone- and tissue-forming materials ; and (2) the importance of the quality, as well as of the quantity, of the albuminoid matter, which contains the constructive materials essential to the production of lean flesh and to the repair of waste tissue. For example, the very special value possessed by such a food stuff as fish meal is doubtless due to the fact that it supplies an amount of mineral matter probably sufficient for the requirements of most quickly growing animals, and that it is very rich in digestible albuminoid matter, derived from an animal source.

The object of the present article is to give a brief account of a series of experiments with a feeding stuff—whale meat—

which is comparatively little known to practical feeders and which, there is reason to believe, contains all the necessary attributes that go to make up an animal food of more than ordinary value. It has long been known to those connected with whaling stations that whale flesh has a most beneficial effect when fed to pigs, and that almost unlimited feeding of this nature appears to produce no injurious effects. Red whale flesh, indeed, is very highly regarded as an article of diet by the staffs of whaling stations and, generally, wherever a supply of the fresh meat is available, as for example in Japan. It seems astonishing, therefore, that no systematic inquiry has yet been made regarding the exact nutritive value of this whale meat. Up to within the last few years, indeed, but little endeavour has been made to utilise the enormous bulk of this red meat, which remains behind after the blubber has been removed from the carcasses. There seems no reason why this product from the whaling industry should not be profitably utilised as a nitrogenous feeding stuff for farm stock, provided a fresh and uncontaminated supply of the raw material can be always obtained.

By arrangement with Ocean Harvest, Ltd., supplies of experimental material were made available from 1924 onwards. These included meat meals and a special product named "meat flakes." The *meat meal*, which had been subjected to a considerable heat in its preparation, was darker in colour and had a stronger odour than the flakes. The *whale meat flakes*, which had been prepared at a lower temperature with the object of retaining as much as possible of the nutrient properties of the original material, varied in colour from light yellow to dark brown, and in texture from a crisp flake to a granular powder. They were practically devoid of taste, but had a distinct though not unpleasant smell.

In order to investigate thoroughly the feeding value of these whale meat foods it was decided to arrange experiments to include the feeding of these products to :—

(1) Pigs of all ages.
(2) Young calves—for a period after weaning.
(3) Yearling cattle.

Up to the present time more than 100 pigs have been used for experimental purposes during this investigation, and a large number, not under experiment, have been fed on a diet containing a varying percentage of whale meat products.

LITTERS PRODUCED ON WHALE MEAT MEAL

FIG. 1. A group of three litters are shown in the top illustration and individual litters in the other two.

Numerous analyses indicate that the composition of these whale by-products may be taken as follows :—

	Whale Meat Flakes	*Whale Meat Meal*
	per cent.	*per cent.*
Moisture	10 to 14	5 to 10
Oil	8 to 12	10 to 20
Albuminoids	60 to 65	60 to 65
Ash	15 to 20	15 to 20
Other constituents .. .	—	—

It will be observed that the ash content of both products is high and that the whale meats are very rich in albuminoids and oil. The experimental work was arranged to determine the feeding value of the protein and to cover the possibility of any harmful effects arising from the oil.

It was apparent from the analysis that a concentrated feeding stuff such as fish meal would provide a suitable means of estimating the approximate feeding value of whale meat products and, hence, a good sample of white fish meal was chosen as the protein-containing constituent of the control rations in the first series of experiments.

The composition of the whale meat flakes, whale meat meal and white fish meal used in the preliminary series of experiments was as follows :—

	Whale Meat Flakes	*Whale Meat Meal*	*White Fish Meal*
	per cent.	*per cent.*	*per cent.*
Moisture	11·38	5·72	13·0
Oil	12·60	21·51	4·4
Albuminoids . ..	57·25	51·18	55·5
Ash	18·17	17·13	24·9
Other constituents ..	0.60	4·46	2·2

Preliminary Series of Experiments.—(1) *Pork Production with Whale By-Products.*—For the first experiment with whale meat products, four pens of four pigs each were very carefully selected from two even litters. The litters were out of Cumberland sows by a Middle White boar. Each pen of four pigs contained, as far as possible, an equal number of pigs from each litter; the sexes of the pigs were fairly equally distributed throughout the four pens. The litters were farrowed on October 5 and 8, 1924. The age of the pigs at commencement of experimental feeding was approximately ten weeks, when the average weight of the pigs was 22½ lb.

It was decided to arrange the feeding of the various pens as follows :—

		Rations per cent.				
Pen No. 1	Barley Meal	39·2	Sharps	53·6	White Fish Meal	7·2
„ No. 2	„ „	38·2	„	55·8	Whale Meat Meal	6·0
„ No. 3	„ „	39·2	„	55·3	Whale Meat Flakes	5·5
„ No. 4	„ „	40·6	„	45·5	„ „ „	13·9

The pigs were taken to small pork weight (approximately 5 score live weight) on the above rations. There were fed "wet" twice a day (8 a.m. and 4.30 p.m.), and in strict accordance with their live weight, the object being to feed to each pen of pigs just sufficient for them to clear up the quantity given in from 10 to 15 minutes Each day at noon each pen received from 4 to 6 lb. of green kale and a supply of carbonate of lime, more or less *ad lib.*

The pigs were weighed regularly once a week during the course of the experiment ; occasionally twice a week during the first few weeks of the feeding period. It is of interest to note how quickly the little pigs responded to this feeding. The following results are calculated from the weights, etc., taken during the first three weeks feeding period :—

	Live weight increase per pig per day	*Lb. of mixture consumed per lb. live weight increase*
Pen No. 1 (White Fish Meal)	·70 lb	2·48
Pen No. 2 (Whale Meat Meal)	67 lb	2 60
Pen No. 3 (Whale Meat Flakes)	·80 lb	2·10
Pen No. 4 (Excess Meat Flakes)	·85 lb	2·10

All the pigs were ready for killing in from ten to twelve weeks from the commencement of feeding, the pigs in Pen No. 4 being ready about fourteen days before the others, while those in Pen No. 2 were the slowest to attain the required weight.

The results throughout the complete feeding period may be expressed shortly as follows :—

	Live weight increase per pig per day	*Lb. of meal consumed per lb. live weight increase*
Pen No. 1 (White Fish Meal)	·93 lb.	3·01
Pen No. 2 (Whale Meat Meal)	·85 lb.	3·17
Pen No. 3 (Whale Meat Flakes)	·96 lb.	3·00
Pen No. 4 (Excess Meat Flakes)	·99 lb.	2·55

These figures do not include the green kale fed daily to each pen. From this preliminary experiment it was considered permissible to deduce that whale meat meal and white fish meal contain approximately similar food values for pigs, and that whale meat flakes possess a feeding value apparently slightly

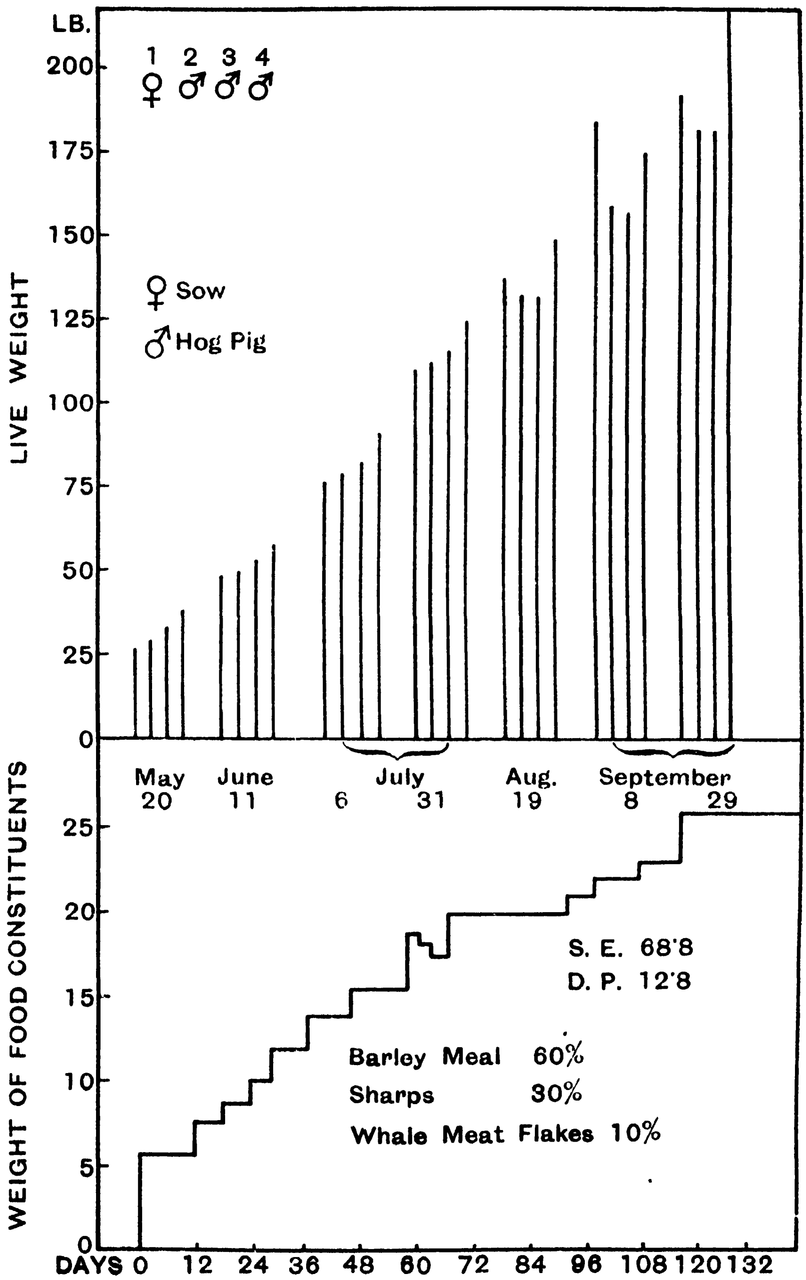

FIG. 2.—Showing the Growth of individual pigs and Food Consumption of group under the Experimental Ration.

superior to both. On this account it was decided to concentrate in the future upon the flaked whale meat rather than upon the whale meat meal, and although further pig feeding experiments were carried out with the whale meat meal, they need not be described here.

(2) *Bacon Production with Whale By-Products.*—At this stage all the pigs in Pen No. 2 were killed as porkers, two pigs were also killed from Pen No. 1 and two from Pen No. 3. One pig from Pen No. 4, *i.e.*, the pen on excess whale meat flakes, was killed and dressed by the local butcher, and portions from all parts of the carcass were distributed to more than fifty people, in order to make a preliminary investigation into the question of possible defect in the pork, following the feeding of a fairly heavy ration of whale meat right up to the morning of killing. No complaint of any nature was received. The remaining two pigs in Pen No. 1 and Pen No. 3, and two out of the remaining three pigs in Pen No. 4, were then carried on to bacon weight in a feeding period of a little over two months, Pen No. 4 being again ready for slaughter a short time before the others. As is customary, the protein content of the rations was slightly reduced during the last six weeks of feeding, so that, throughout the whole feeding period, the percentage composition of the rations averaged :—

Pen	No. 1	2 pigs.	Barley Meal	39·2	Sharps	53·9	White Fish Meal		6·9
,,	No. 3	,,	,, ,,	39·7	,,	55·1	Whale Meat Flakes		5·2
,,	No. 4	,,	,, ,,	41·6	,,	45·6	,,	,,	12·8

The results over the whole feeding period were :—

	Live weight increase per pig per day	*Lb. of meal mixture consumed per lb. live weight increase*
Pen No. 1 (White Fish Meal) 2 pigs	1·15 lb.	3·4
Pen No. 3 (Whale Meat Flakes) 2 pigs	1·29 lb.	3·24
Pen No 4 (Whale Meat Flakes) 2 pigs (Excess) ..	1·32 lb.	3·30

It will be observed that Pen No. 4 has not quite attained the result that was anticipated from its performance during the porker trial. This may be because the two pigs in this pen were pushed forward very rapidly (they were ready for slaughter as baconers a week or so before the others) and were possibly fed a heavier ration of meals than they could use economically, and also because it is very probable that the percentage of protein in the ration was rather high for pigs in the last stages of fattening. It should be pointed out that the daily gain in live weight of this pen is high and that the two pigs always

showed a very fine " bloom " and appeared to be pigs " doing " very much better than the others. All the pigs were now forwarded to the local bacon factory, with the exception of one gilt from Pen No. 4 which was retained for breeding purposes. On slaughter the pigs fetched top prices, the flesh being of good colour and the fat fairly firm, white and not too plentiful. Inspection of the sides and hams after curing revealed little difference between the quality of the control and experimental pigs, with the exception of the pig from Pen No. 4. The sides from this pig appeared to be softer than the others, but the fat was of good colour and possessed no unusual odour. Small portions of the back and body fat were taken from each pig before curing, and constants, such as the melting point and iodine value, were subsequently ascertained. The results could not be correlated with the feeding or with any observed softness. Portions from all the sides were distributed amongst a varying number of people in order to investigate the question of possible taint in the bacon. Portions of the sides and gammon from the pig in Pen No. 4 were sold to between forty and fifty people and in no instance was any unusual flavour reported. The absence of any taint from the finished sides, etc., even when the whale flake feeding was pushed to great excess, was regarded as satisfactory at this early stage of the investigation, since it is well-known that although no taint may be apparent in a freshly killed carcass, a very appreciable taint may develop during the process of curing.

The remaining pig from Pen No. 4 and the fourth pig from this pen (which had been fed with the same proportion of whale meat flakes), were now put on a ration containing 15 per cent. of whale meat flakes, 35 per cent. of barley meal, and 50 per cent. of sharps. After being fed on this diet for a period of more the three months one was killed as a bacon pig. A further searching inquiry revealed no suspicion of any undesirable taint. The remaining pig was kept on the above ration, served, and in due course farrowed down, then being little over a year old. This gilt had eleven nice pigs of which she was permitted to rear nine. While nursing, the sow received the same 15 per cent. of flaked whale meat and from the age of three weeks the little pigs were dry fed on a ration containing 10 per cent. of whale meat flakes and equal parts barley meal and sharps. The litter was weaned at ten weeks old, when the average weight of the little pigs was just under 33 lb. This preliminary series of experiments would seem to demonstrate

2 D

that whale meat—more particularly flaked whale meat—has a definite feeding value and that it contains all the factors necessary for reinforcing the normal cereal rations fed to pigs and for promoting quick growth and general well-being.

Confirmatory Series of Experiments.—*Bacon Production with Whale Meat Flakes.*—In May, 1925, a more comprehensive experiment was commenced with flaked whale meat. Four comparable pens of four pigs each were carefully selected from three litters of pure Middle White pigs. The average weight per pig at the commencement of the feeding period was 39 lb. As far as was possible, each pen contained the same number of pigs from each litter and the sexes were distributed as evenly as possible throughout the four pens. The relative growth rate of the four pens of pigs having been found to be approximately similar, the feeding of the experimental and control pens was arranged as follows :—

	Experimental Ration (*Fed to Pens* 1 *and* 3) *per cent.*	*Control Ration* (*Fed to Pens* 2 *and* 4) *per cent.*
Barley Meal . .	60·0	50·0
Sharps .. .	30·0	25·0
Whale Meat Flakes .	10·0	—
Bean Meal	–	12 5
Extracted Decorticated Groundnut Meal	—	12·5
Estimated starch equivalent	68·8	68·5
Estimated digestible protein	12·8	13 8

The starch equivalent and digestible protein content of the flaked whale meat were assumed for the purposes of the experiment as being respectively 70 per cent. and 50 per cent., that is, reckoning 70 per cent. of the total oil digestible and 87 per cent. of the total protein digestible. In addition to the meal diet the sixteen pigs each received a small allowance of green food—generally in the form of cut grass—each day at noon ; they also received a supply of carbonate of lime more or less *ad lib.* Each pen of pigs was allowed about fifteen minutes exercise in an open yard every day while the pens were being cleaned out. Throughout the experiment all the pigs " did " well, but it was always obvious that the pigs on the experimental diet thrived the best. They showed a wonderful " bloom " throughout the whole feeding period and were ready for slaughter rather earlier than the control pigs.

Figs. 2 and 3 illustrate the growth of the individual pigs in an experimental and control pen ; the pigs in the duplicate pens gave very similar results.

The weights of the four pigs in each lot, and always in the same sequence, are represented by the length of the vertical lines, dates being selected at intervals as space permits; curved lines passing through the upper ends of each of these lines in turn, would as a rule pass through the points indicating intermediate weighings, for the growth of all the pigs was satisfactory.

The lower part of each figure indicates the quantity of food given each day to the group of pigs, the steps indicating the days from the commencement of the experiment on which it was thought necessary to increase the quantity of food. This point was determined as mentioned above, by noting the avidity with which the pigs cleaned up their rations and by comparison of the live weights with the recognised requirements of the animals.

The upper lines, representing the weights of the pigs, are situated as nearly as space permits above the quantity of food supplied on the day of weighing.

The results of this feeding experiment may be expressed as follows :—

	Average live weight increase per pig per day	*Lb. of meal mixture consumed per lb. live weight increase*	*Average percentage dressed dead weight on fasted live weight*
Experimental Pens 1 and 3 (8 pigs) ..	1·16 lb.	3 65	73·0
Control Pens 2 and 4 (8 pigs)	1·0 lb.	3 86	71·7

On slaughter all the pigs killed well and fetched top prices, the quality in all cases being good, as judged by the local bacon trade. The back fat from the pigs on the experimental diet did not seem unduly soft and the carcasses were remarkably full of lean meat. A very minute investigation was made into the question of any taint likely to have developed during the process of curing, and again the result was negative; in no instance was any unfavourable report received.

Whale Oil Feeding Experiment.—In order to investigate still further the very important question of the influence of the oil a special feeding experiment was performed in the summer of 1925. Two strong healthy young pigs were carefully selected and for a period of nearly four months were fed a ration consisting of, barley meal 60 per cent., bean meal 20 per cent. and extracted palm kernel meal 20 per cent. This ration is very low in oil content, but to each pig was fed during the four months

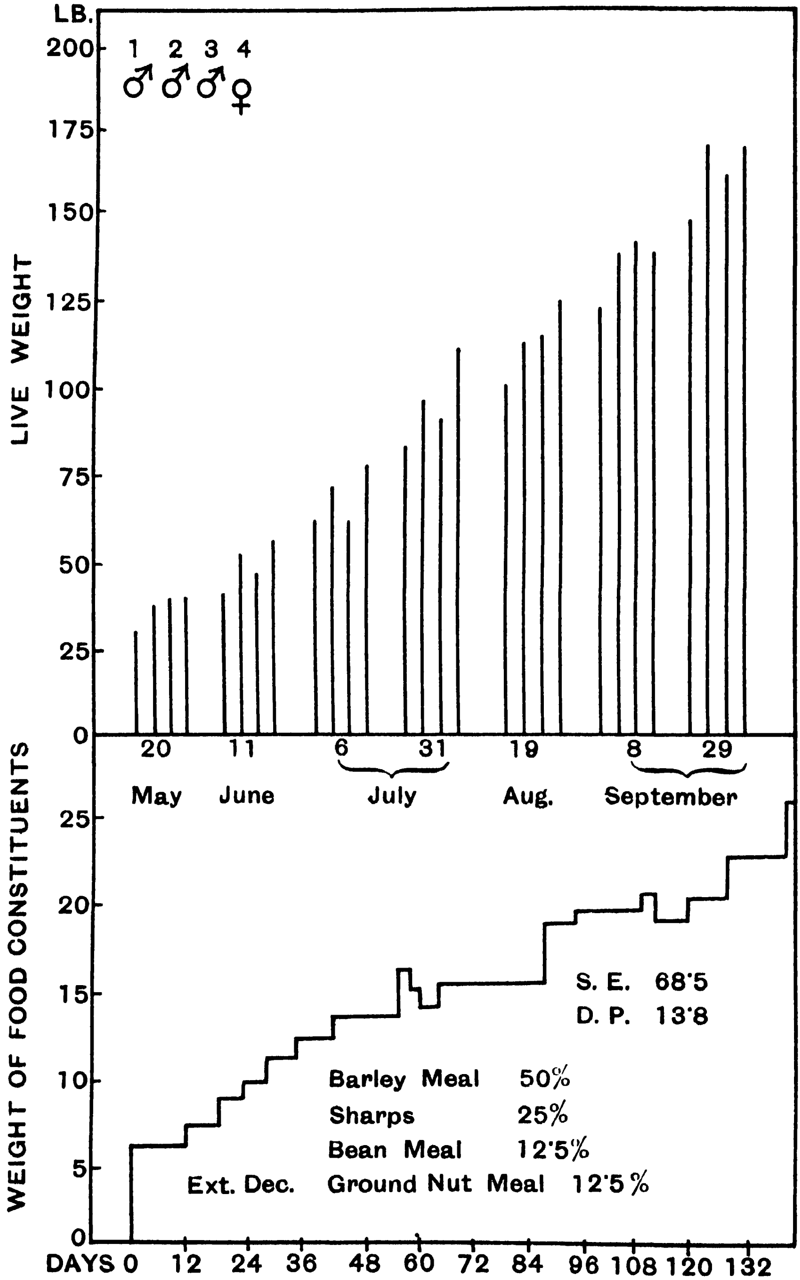

FIG. 3.—Showing the Growth of individual pigs and Food Consumption of group under the Control Ration.

a percentage of whale oil. One pig received over 1 oz. per day of high grade oil and the other about 1 oz. per day of the lowest grade whale oil that it was possible to obtain. This crude whale oil was very black in colour, almost as dense as coal tar and had a most unpleasant odour. For the first ten days or so of this experiment it was obvious that the pigs did not relish the oil feeding, but within a period of three weeks they consumed their allowance greedily, always provided that it was thoroughly mixed up with the food. The pigs thrived surprisingly during the summer and when killed last autumn one weighed just under 8 score and the other just over 9 score live weight. On slaughter, although the most minute investigation was made, no evidence of any taint was reported. More than 50 lb. of the pork were distributed for tasting purposes—the remainder of the carcasses being sold to the general public in the ordinary way, and no unfavourable report was received. Portions of the fats were carefully extracted and the usual constants ascertained. The body fat from the pig receiving the high grade oil gave a positive hexabromide test, but that from the low grade oil was negative.

Bacon Feeding Experiment with an Extracted Whale Product.—Whale oil has a considerable commercial value, and is moreover easily extracted by modern technical methods. It was of practical importance to determine if such extraction reduced the feeding value of the residual product, or if, on the other hand, the more nitrogenous extracted residue was of greater value as a food for pigs. For this purpose eight Middle White " weaners " were carefully selected and divided into two comparable pens—an experimental and a control pen. To each pen was fed the same ration—barley meal 60 per cent., sharps 30 per cent., whale meat flakes 10 per cent.—but the experimental pigs received extracted and the control pen non-extracted flaked whale meat.

The extracted flaked meat contained roughly 3 per cent. of whale oil and the non-extracted about 12 to 13 per cent. of whale oil. Both the extracted and the unextracted whale meal were manufactured from carcasses from which the bone had previously been removed ; these products therefore contained little or no calcium phosphate. In this experiment, the two pens of pigs received as much calcium carbonate as they cared to pick up, but were offered no other source of calcium phosphate than that contained in the cereal part of their diet. From the commencement of the experiment, the two pens of pigs were

carried to bacon weight in a feeding period of less than five months.

The results of this experiment are :—

	Live weight increase per pig per day	*Lb. of meal mixture consumed per lb. live weight increase*
Pen No. 1 (extracted oil pen)	1·05 lb.	3·8
Pen No. 2 (non-extracted pen)	1·05 lb.	3·8

The result would seem to indicate that there is no difference in feeding value between equal weights of extracted and non-extracted whale meat flakes : the reduction in fat in the extracted flakes being apparently compensated for by the consequent increase in the percentage of protein.

On comparing the quality of the pigs on slaughter and after curing it was of particular interest to find that while all the carcasses were graded first quality, the sides from the pigs receiving the unextracted whale meat were decidedly firmer than the sides from the pigs receiving the extracted meat. This was evident on inspection and was subsequently confirmed in the laboratory. The iodine values of the back fats from the pigs in both pens were ascertained, and it was found that, in every case, those obtained from the fats of the pigs receiving the unextracted whale meat were lower than those from the pigs receiving the extracted meat. In other words, the fat of the oil-fed pigs was firmer than that of the pigs receiving the extracted meat. None of the samples of back fat taken from the pigs receiving the unextracted whale meat gave a positive hexabromide test. These results contradict the prevailing opinion that the firmness of the fat is greater or less as the oil present in the diet increases or decreases. Further experiments of the above nature will have to be conducted before conclusive evidence can be obtained, but, in the light of present knowledge, it seems permissible to advance the suggestion that the production of a firm bacon fat is the result of a perfectly balanced physiological diet, rather than due to the amount of oil present in the food.

Pork Feeding Experiments with Whale Meat Flakes.— During last winter a further series of experiments was performed with whale meat flakes, 28 pigs being used for this purpose.

In a first experiment eight pigs from one litter were carefully divided into two comparable pens—and to one pen was fed a ration containing 60 per cent. of barley meal, 30 per cent. of wheat sharps and 10 per cent. of whale meat flakes. The control pen received a ration containing approximately similar

nutrients, but consisting of barley meal 58 per cent., sharps 30 per cent., and white fish meal 12 per cent. The average weight of the pigs at commencement of the experiment was $35\frac{1}{2}$ lb. On the above rations the pigs were carried to small pork weight (100 lb. live) in a feeding period of from ten weeks to three months duration. Each day at noon the pigs received a small quantity of green kale, and as much calcium carbonate as they cared to pick up. They were allowed very little exercise and were confined indoors during the night.

The results of this experiment may be expressed shortly as follows :—

	Live weight increase per pig per day	*lb. of meal required to produce 1 lb. live weight increase*
Pen No. 1 Experimental (10 per cent. Whale Meal Flakes)	96 lb	2 9
Pen No 2 Control (12 per cent White Fish Meal)	99 lb.	3 1

In a second series eight even pigs were divided into two comparable pens and the rations fed were indentical with those above.

	Live weight increase per pig per day	*lb of meal required to produce 1 lb live weight increase*
Pen No. 1 Experimental (10 per cent Whale Meat Flakes)	92 lb	3 19
Pen No. 2 Control (12 per cent. White Fish Meal) .	85 lb	3 50

In a third and last series the results confirmed those obtained above ; in each case the experimental pigs required slightly less food to produce each lb. of live weight increase, and generally were ready for slaughter rather sooner than the controls.

Whale Meat for Breeding Sows.—It was considered of practical importance to investigate the effect (if any) on feeding to pregnant and nursing sows a diet containing a percentage of whale meat. For this purpose nine sows were selected (eight Middle White and one Middle White cross) and were fed the following ration during pregnancy and while nursing :—

	Per cent.
Barley	40
Sharps	30
Extracted Palm Kernel Meal .	20
Unextracted Whale Meat Meal ..	10

The results of this experiment may be described as follows:—

Sow No.	*Date Farrowed,* 1926	*No. of living pigs born*	*No. of pigs reared to weaning age*	*No. of Pigs weighed*	*Weight of litter. 16–24 hours after birth. Average weight of single pig* lb.	oz.	*Age when weaned. Average weight of single pig at weaning* wks.	lb.
I	April 21	14	14	14	36 2	13 10	9	30
II	May 4	14	14	14	35 2	1 8	8	25
III	May 15	15	13 (2 "laid on" within 12 hrs.)	13	31 2	10 7	9	28
IV	May 30	10	9 (1 died within 12 hrs.)	9	26 2	7 15	8	28½
V	June 14	14	11 (1 died and 2 others "laid on" June 16)	13	36 2	0 12	*	

The following sows were "run" outside and farrowed in open yards.

					wks.	lb.
VI	March 5, 1926 .	9	8	Not weighed	8	35
VII	March 12, 1926. .	10	7	do.	11	40
VIII	March 12, 1926	11	9	do.	11	34
IX	April 28, 1926 .	11	9	do.	-	-

Total Number of Pigs Farrowed from 9 sows . . 108
Total Number of Pigs Reared from 9 sows . . 94
Average reared per sow 10.4

Conclusions.— During the past eighteen months experiments have been conducted on whale products as a food for pigs. The total number of pigs used to July, 1926, was 115. Whale meat meal and whale meat flakes have been fed to pigs for the production of pork and bacon, and to breeding sows, in proportions varying from 5·2 to 15 per cent. of the rations used. The results have been compared with white fish meal of good quality, or with bean meal and extracted decorticated ground nut meal.

As judged by the live weight increase per pig per day the whale meat meal was slightly inferior to white fish meal but the whale meat flakes were throughout superior to the fish meal, and to bean meal and decorticated ground nut meal as used in rations containing approximately equivalent nutrients. Comparing the pounds of food consumed per pound of live weight increase the above results were confirmed.

* Not yet weaned. Average weight of single pig at 6 weeks = 17 lb.

The pigs fed on whale meat were ready for the butcher earlier than the others, and also showed a finer " bloom."

The resulting pork and bacon were subjected to tests for possible taint or flavour but in no case was an adverse report received.

Extracted was compared with non-extracted whale meat, and whale oils were also fed to pigs. Evidence obtained at present indicates that the whale oil does not produce any taint in the carcasses and so far from softening the resulting pig fat it rather seems to have the reverse effect. Further experiments on this point are necessary.

Sows when fed on a diet containing 10 per cent. of whale meat flakes produced good litters. The same feeding was continued during the lactating period with satisfactory results.

THE GROWING OF WINTER OATS

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ALTHOUGH oats are by far the most important of the cereals grown in Wales, only a very small proportion of the crop is sown in the autumn. Having regard to the economic conditions now obtaining, particularly in certain districts, it has seemed desirable, nevertheless, to study the growing of winter varieties, both in regard to the varieties among themselves and also for comparison of the best of them with the best of the spring varieties.

Trials have been conducted at the Welsh Plant Breeding Station during the five seasons, 1920-25. The field plots have varied in size from 1/40th acre to 1/300th acre, and each variety has generally been replicated four times. During the first two years, the plots were square with the replicate plots arranged on the checker board system ; but in the later trials oblong narrow plots were found more suitable. Owing to the pronounced effect of the paths on the borders of the plots, it was found advisable to exclude a foot width of the crop all round each plot. The seed was usually broadcast on the furrow,* but in the autumn of 1922 the soil was so friable that the seed had to be drilled in order to ensure a satisfactory covering.

* Which conforms to common local practice.

1922-23 Trial.*—In order to test the winter resistance of oats under particularly adverse conditions of exposure and supply of plant food, this trial was carried out on very poor soil—shaly and shallow—the field being one of the most exposed at the station. The winter varieties—Black Winter and Grey Winter—were drilled on October 17 at the rate of, approximately, five bushels per acre, whilst the spring varieties —Record and Radnorshire Sprig—were drilled on April 4 following at the same rate of seeding, home-grown seed being used in both cases. The autumn-sown varieties brairded well and evenly about November 5, and withstood the winter quite effectively in spite of the exposed situation. The weather during the winter was fairly mild without much hard frost. By the beginning of March these plots were green and the plants quite healthy, very few plants having died off during the winter. The number of tillers per plant at that time ranged from three to five, but when the time came for these tillers to " shoot "—about the end of March—not more than a single tiller elongated on most of the plants, the remaining tillers soon shrivelling up. This was probably due to the very poor nature of the soil and to the cold, dry weather, just at the time these varieties were ready to commence a period of active growth. The resulting crop, therefore, became fairly thin. To make things still worse for this crop there occurred another spell of adverse weather—cold and dry—at the critical period just before the emergence of the panicle, a period which more critical trials in progress have shown to govern the straw yield to a marked degree.

The spring-sown lots brairded quickly and evenly but made very little growth during the cold weather which lasted up to the middle of June. With the advent of warmer weather, during the latter half of June, and the beginning of July, these lots grew fairly vigorously and produced quite a fair crop for such poor soil, the crop being thicker and the plants shorter and stouter than in the autumn-sown lots.

It is of importance to notice that the autumn-sown varieties carried on their growth and elongated during the months of April and May in spite of the cold weather, and came into panicle in the middle of June, with the result that they were unable to take advantage of the warmer weather during the latter half of June and the beginning of July, and their

* For full details of the trials conducted in 1920-21 and 1921-22, *see* the Station Bulletin, Series C. No. 3.

TABLE I.—TO SHOW YIELD AND OTHER DATA FOR WINTER & SPRING VARIETIES OF OATS. STATION TRIAL, 1922-23

Variety	Date of sowing	Date of heading	Date of ripening	Height to tip of panicle when ripe *cm*	Yield of grain *in cut per acre*	Proportion of kernel in the grain *per cent*	Yield of kernel *in cut per acre*	Weight of grains *grammes per 1,000*	Yield* of straw *in cut per acre*	Total weight of crop *in cut per acre*	Ratio—grain total: *per cent*	Rainfall for last 20 days before heading including date of heading *inches*	Accumulated temperature above 42°F. for the period extending from 20 days before heading stage to 10 days after heading. *Day degrees*
Grey Winter	Oct. 17	June 13	Aug 5	101	5·3	76·7	4·1	29·3	12·9	18·2	29	·47	323
Black Winter	,,	,, 19	,, 3	97	6·3	73·6	4·6	41·8	13·8	20·1	31	·89	362
Bountiful	,,	,,	,, 2	97	7·5	73·4	5·5	43·4	14·4	21·9	34	·89	362
Record	Apr. 4	July 7	,, 22	63	10·6	70·8	7·5	32·3	16·7	27·3	39	·79	530
Radnorshire Sprig	,,	,, 2	,, 14	58	9·1	69·2	6·3	24·0	14·4	23·4	39	·97	478

* In all the tables the yield of straw includes chaff, the straw weight being taken as the difference between the total weight of crop and the weight of grain

TABLE II.—TO SHOW YIELD AND OTHER DATA FOR WINTER & SPRING VARIETIES OF OATS. STATION TRIAL, 1923-24

Variety	Date of sowing	Date of brairding	Date of shooting*	Date of heading	Date of ripening	Height to tip of panicle when ripe *cm*	Yield grain per acre: *cut*	Proportion kernel in grain *per cent*	Yield of kernel per acre *cut*	Weight grains *grammes per 1,000*	Yield straw per acre *cut*	Total yield per acre *cut*	Ratio—grain total: *per cent.*
Grey Winter . . .	Oct 31	Dec. 20	Apl 24	June 20	Aug 23	142	20·8	77·1	16·3	30·7	43·7	64·5	32
Black Winter . .	,,	,,	,,	,, 22	,, 27	140	21·5	75·4	16·2	41·5	41·9	63·4	34
Record . . .	Mar 26	Apl 14	May 7	July 9	Sep 10	128	19·9	72·5	14·4	35·2	34·0	53·9	37
Radnorshire Sprig . .	,,	,,	,,	June 30	Aug 28	116	23·2	71·5	16·6	29·3	25·9	49·1	47

* By "shooting" is meant the first signs of elongation of the straw (or shoot), the standard adopted, viz., that of the average height to the uppermost ligule being 4 cms.

vegetative growth was curtailed to a considerable extent. The spring-sown lots, on the other hand, made very little headway during April and May, and were still in the active growth stage—lengthening of the straw and the emergence of the panicle—when the more favourable growing weather of June and July occurred. A very similar phenomenon in the case of plants in a somewhat younger stage of growth was observed by Finlay,* who, when testing the crop-producing capacity of seed of different sizes, in one case found the smaller seed to give the best crop. In that particular case, he attributed the rather unusual results, not to any intrinsic character in the seed itself, but to the fact that the plants from the smaller seed, being in a younger stage of growth than those from the larger, were able to profit more from a particular spell of favourable growing weather than were the corresponding plants from the larger seed which, although sown on the same date, had from the start grown away more rapidly.

For a cold season, such as 1923, the significance of the precise temperatures which obtained in the case of the several varieties during the periods when growth was most active, is well illustrated by the data shown in Table I, from which it will be seen that the accumulated temperature above 42° F., for the period coinciding with the heading stage, is closely correlated with the yield. For the period extending from twenty days before the heading stage to ten days after its completion, the temperature was sufficiently high at the dates corresponding with this stage of growth in the case of Record to give 530 units of warmth (day-degrees), and the total crop was 27·3 cwt. per acre. For the corresponding period (nearly a month earlier) in the case of Grey Winter, the temperature remained so low that only 323 units of warmth were developed and the total crop was only 18·2 cwt. per acre.

1923-24 Trial.—This trial was conducted at the station, but in this case the soil was of high fertility and the field in a sheltered position. The winter varieties were Grey and Black Winter, while the spring varieties, used for comparison, were Record and Radnorshire Spring. The seed used was home-grown in all cases, but, for the autumn sowing, yearling seed was employed in the case of both varieties.

The autumn varieties were sown on October 31, the seed being broadcast on the furrow at the rate of four million

* Finlay, Wm. M., "Size of Seed." N. of Scot. Agri. College, Bul. No. 23.

viable seeds per acre.* The weather was very cold and wet, so that the plants did not braird until December 20, and by the end of the year they were only in the "spear-stage," but quite healthy. The month of January was very wet, there being practically no growth, whilst many of the plants died out. At this stage also starlings nipped off a small proportion of the plants at ground level, but this was done fairly uniformly over all the plots. The weather continued very cold during the months of February and March, so that there was very little growth till the end of March, when tillering commenced, most of the plants sending up three to five tillers, practically all of which produced panicles, though the later-formed tillers caused the processes of heading and ripening to be somewhat uneven.

A dressing of 1/5th cwt. per acre of nitrate of soda was applied on May 5, in order to make the manurial treatment similar to that which had to be given to the spring-sown section. The spring varieties were sown on March 26, and their treatment differed from the winter varieties only in being sown at the rate of $2\frac{3}{4}$ million viable seeds per acre.† These plots brairded quickly and evenly, but afterwards did not seem to make much headway for some time, whilst an occasional plant showed signs of attack by wireworm and fritfly. As a protection against these pests a very light dressing of nitrate of soda at the rate of 1/5th cwt. per acre was given on May 5. Subsequently the plants made vigorous growth, but rarely produced more than one tiller each, the crops being rather thin in consequence. Nevertheless, all the plants came into panicle together and ripened very evenly.

In this trial the winter oats compared very favourably with the spring-sown varieties, as regards yield of grain per acre (*see* Table II). When the yield of kernel per acre is considered the superiority of the winter varieties over Record is much more marked—the grain of the Grey Winter consisting of a strikingly high proportion of kernel in spite of the somewhat uneven ripening. Where the winter varieties far outweighed the spring varieties was, however, in the yield of straw per acre—Black Winter gave 23 per cent. and Grey Winter 28 per cent. more than Record, whilst Radnorshire

* This corresponds to a seeding of 2·3 cwt. per acre of Grey Winter and 3·2 cwt. per acre of Black Winter. Two-thirds of this seeding would usually be ample on a field scale, since birds would not be so likely to cause the same damage as on a small area under plots.

† This corresponds to a seeding of 2 cwt. per acre of Record.

Sprig gave even less than Record. Though the straw yield of the winter varieties was so heavy per acre it was by no means coarse, but tall and fairly fine for the height, being more resilient and tough, with less tendency to buckle and snap, than that of the spring varieties.

Comparing the winter varieties between themselves, it was noted that the Grey had slightly finer straw than the Black, a difference which was probably influenced to some extent by the thicker stand in the plots of the Grey variety.

1924-25 Trials.—*I. Station Trial.*—This was conducted on very shallow soil of a light, shaly nature and poor in nitrogeneous elements; a dressing of 4 cwt. per acre of superphosphate was given in the autumn just previous to sowing. The field, a very exposed one, stands at 450 feet above sea-level.

The autumn-sown varieties consisted of Grey Winter, Black Winter, Marvellous and Golden Rain. Prime new seed of each variety was obtained and broadcast on the furrow at the rate of 2½ million viable seeds per acre*—the same rate as that adopted for the spring sowings. The sowing was carried out on October 31, and all the varieties brairded quickly and evenly. Owing to the mild weather during the first three weeks in December, they all made a fair amount of growth, so that by December 20 the second leaf was just appearing in both Marvellous and Golden Rain, whilst it had already appeared some four days earlier in the Grey Winter and Black Winter. During the last week in December and the first week in January, heavy showers of rain and hail fell, and at the same time strong north-easterly gales arose, accompanied by intense cold. This proved fatal to Golden Rain, practically all the plants being killed, while only one-fifth of the original number of plants of the variety Marvellous was able to survive. During this trying period all the Grey Winter and Black Winter plants were laid flat on the ground, being bent right over at the surface of the soil. Nevertheless, about three-quarters of these plants survived, and though they made no headway during January and the first half of February, the weather being cold and the ground sodden, they picked up again and tillered (up to about three tillers per plant) during

* This worked out at about :—

2 cwt. per acre for Black Winter and Marvellous.
1·8 ,, ,, ,, Record and Golden Rain.
1·5 ,, ,, ,, Grey Winter and Radnorshire Sprig.

TABLE III.—TO SHOW YIELD AND OTHER DATA FOR WINTER v. SPRING VARIETIES OF OATS. STATION TRIAL, 1924-25

Variety	Date of sowing	Date of braird-ing	Date of shoot-ing	Date of heading	Date of ripen-ing	Ht. to tip of panicle when ripe : *cm.*	Yield grain per acre : *cwt.*	Pro-portion of kernel in grain : *per cent*	Yield kernel per acre : *cwt.*	Weight of grains : *grammes per* 1,000	Yield straw per ac. *cwt.*	Total wt. of crop per ac. *cwt.*	Ratio -grain total : *per cent.*	Rain-fall 24 days before head-ing : *In.*	Accumulated temperature above 42° F. for period 20 days before heading to 10 days after. *Day degrees*
Grey Winter . .	Oct. 31	Nov. 24	Apl. 20	June 14	July 31	109	18 1	78 0	14·1	31 0	25 0	43 1	41 9	1 673	425
Black Winter	,,	,,	,,	,,	,,	106	16·8	75 4	12 7	41 0	28·9	45 7	36 8	1 673	425
Marvellous . .	,,	,, 21	,,	,, 17	,, 30	107	10·6	70·3	7 5	41 1	15 1	25 7	41 3	1 541	432
Record . .	Mar. 18	Apl. 10	May 29	,, 30	Aug. 24	73	17·8	74·3	13 2	38 7	15 8	33 6	53 0	·077	433
Radnorshire Sprig	,,	,,	,, 27	,, 24	,, 10	77	14 5	71 0	10 3	28 4	15 6	30 1	48 2	·069	485

TABLE IV.—TO SHOW YIELD AND OTHER DATA FOR WINTER v. SPRING VARIETIES OF OATS WHEN GROWN AT HIGH ELEVATION AND EXPOSED SITUATION, 1924-25

Variety	Date of sowing	Date of heading	Date of ripening	Yield of grain : *in cwt. per acre*	Proportion of kernel in the grain *per cent*	Yield of kernel *in cwt per acre*	Weight of grains : *in grammes per* 1,000	Yield of straw : *in cwt. per acre*	Total weight of crop : *in cwt. per acre*	Ratio—grain total : *per cent.*
Grey Winter	Nov. 1	June 18	Aug. 10	20 0	77 8	15 6	36·7	43 0	63·0	32
Grey Winter . . .	Apl 9	July 7	Sep. 10	19 6	77 3	15 2	31·2	37·7	57 3	34
Record	,,	,, 9	Aug. 29	19 9	72 0	14·4	35·6	27 2	47 1	42
Radnorshire Sprig . .	,,	,, 3	,, 18	22 0	70·2	15 4	25·1	29 7	51 7	43

the latter half of February and March, and most of the tillers bore a panicle, thus giving quite a moderate stand. The plants of Marvellous which had survived, however, generally produced but one or two small secondary tillers which soon died off, so that the stand was exceedingly thin. During April and May, the three surviving winter varieties made active growth and, although the light shallow soil was soon dried out by the severe drought, these lots were so well established that they produced a fair bulk of straw. Nevertheless, the continued drought forced them to ripen somewhat prematurely.

The spring varieties included Record and Radnorshire Sprig. These were sown on March 18 on plots interspersed with the winter varieties so as to get precisely the same conditions as to soil and exposure. These brairded very quickly and evenly and at first seemed as if they would soon overtake the autumn-sown varieties, but, when the drought came, its effect soon became manifest in the spring lots, the growth of the plants being severely checked.

It is interesting to note that June, the month which plays such an important part in determining the bulk of the oat crop, was a month of severe drought. The almost complete lack of rain, together with the high temperatures, gave a severe check to the vegetative growth of the plants, with the apparent result that they were forced into panicle prematurely. From Table III it will be seen that, after excluding the variety Marvellous, which had an exceedingly thin crop, the total yield per acre is correlated with the amount of rainfall for the period of twenty-four days previous to the date of heading. The winter varieties received 1·6 inches more rainfall during that period than the spring varieties had received during the corresponding period, and gave a 40 per cent. heavier crop than the spring varieties.

In such a season as this—hot and dry—variations in the amount of accumulated temperature seem to have had no effect on the crop, whilst the amount of rainfall, particularly just previous to the heading stage, appears to have been a very important factor. This season shows a marked contrast with 1922-23, when the amount of accumulated temperature was undoubtedly the outstanding controlling factor.

1924-25 Trials.—*II. At High Elevation.*—To test whether winter oats can withstand exposed conditions at high elevations a plot of Grey Winter oats was sown at Pensarn, Cardiganshire, on November 1, 1924. The soil is a light loam

with a tendency to be shaly and, hence, well-drained. The field stands at about 700 feet above sea-level, it has a northern aspect, and is exposed to the sea breeze from the north, but is somewhat sheltered from the south-west, the direction of the prevailing winds. The field was in good heart, having been down to temporary pasture for the three previous years.

The seed was broadcast on the furrow at the rate of four million viable seeds per acre. It brairded quickly, and was in the spear stage at the time of the stormy weather about Christmas. Although the seedlings were laid flat by the storms, they withstood the conditions and soon picked up, afterwards giving a thick stand and tall growth before the drought had much effect. Ultimately the variety ripened well, giving a good yield of grain and a very heavy crop of straw, which stood perfectly erect in spite of the wet weather at the time of ripening. The straw was coarser than any of the spring-sown varieties in the same experiment.

Plots of spring varieties of oats were grown alongside the above, and these were sown at the rate of three million viable seeds per acre, the seed being broadcast on the furrow on April 4. Amongst others, plots of Record, Radnorshire Sprig, and Grey Winter oats from the same bulk as the autumn-sown lot were included. These brairded quickly and evenly, but eventually their growth was checked to a certain extent by the drought, so that, just before the end of the drought period, the autumn-sown plot seemed so much superior to the spring-sown as to yield a crop three times as large. Owing to the lateness of the district, together with the northern aspect of the field, the spring-sown crops, however, did not come into panicle till after the drought had ended, and they were able to respond very markedly to the improved conditions of moisture following the termination of the drought, finally producing a heavy crop, although, in total yield, the advantage remained with the autumn-sown Grey Winter (*see* Table IV). Nevertheless, the straw was fairly fine, particularly so in the case of the spring-sown Grey Winter, which had a very thick crop which was badly lodged just at the time of ripening. It is probable that had the drought lasted another fortnight, the spring-sown crop would have been extraordinarily light, whereas the autumn-sown crop would not have been reduced to any material extent.

Different Seasons (Early and Late).—It has been found that the straw crop in oats is very closely correlated with the

length of the active growing period,* no matter whether this is controlled by the climate or by the nature of the variety itself, together with the accumulated intensity of the factors, which are near their minimum for plant growth during that period. In 1921 and 1925 the limiting factor was the supply of moisture, whilst in 1923 it was the temperature. In seasons like 1921 and 1925, when the crops ripened early, on account of drought and heat, and the active growing period was short, the straw crop was much smaller than usual. The effect of the nature of the variety was very clearly seen in 1922 amongst the spring varieties. The late-ripening varieties gave double the crop of straw that was given by the early-ripening varieties. The difference between the straw yields of the early and the late varieties in that season became more marked owing to the period of active growth starting late in the spring, the temperature being very low. It has also been found that in very dry seasons the yield of grain is closely governed by the amount of straw growth that the plant has been able to make, while, in seasons which are wet and late, the yield of grain is more closely governed by the weather conditions about the time of ripening, the yield generally getting worse and worse as the time of ripening gets later. Early-ripening varieties sown in the spring, therefore, are likely to give very small crops in an early season which is dry and hot, whereas a late-ripening variety will usually give a poor yield of grain in a late season which is wet and cold.

Autumn-sown varieties are more favourably adapted to both of these conditions, being able to produce a fair crop of straw before a summer drought has much effect in dry seasons such as 1921 and 1925, whilst in late seasons, like 1923 and 1924, when the spring-sown varieties do not ripen until well on in September, the autumn-sown varieties ripen quite a month earlier and therefore stand a better chance of having their grain ripened normally. Winter oats are, therefore, able to combine the two useful characteristics of early ripening along with a heavy crop of both straw and grain—two characteristics which are almost incompatible in spring varieties except under the most ideal conditions of growth.

* The active growing period may be taken as that extending from the time when the tillers commence to elongate quickly in the spring (standard adopted being when the uppermost ligule is four centimetres above the ground where no crowding of the plants occur) up to the time when the plant attains its maximum height, *i.e.*, about halfway between the date of heading and the date of ripening.

Economic Considerations.—Under present conditions, a large proportion of the farmers in England and Wales have concentrated their attention on livestock, and have adopted a system of farming by which they grow practically all the food requirements of their stock on their own farms, where, also, are consumed all the crops they grow. The success of such a system of farming is largely dependent upon the proper balancing of the winter supply of fodder with the summer keep. If the summer happens to be very dry, however, the farmer, who relies solely upon spring-sown cereal crops, may find that his food supply for the winter is short for the amount of livestock, so that he is obliged either to sell out some of his stock in a flooded market, or else to buy in fodder at enhanced prices, to which must be added the cost of cartage from the local store or the railway station. On the other hand, in such a season autumn-sown oats would probably yield a heavy crop (*e.g.*, in 1921 and 1925), and thus save the situation for the farmer. Taking such circumstances into consideration it is quite probable that, in many districts, where winter oats are rarely grown over a period of ten years, the *value per acre* of a *portion* of the oat "breadth" sown under winter oats would be greater than the value per acre of the same portion sown with spring varieties.

It is important to note that the "value on the farm itself" differs greatly from the price quoted in the market because the cost of cartage would have to be taken into consideration. In seasons when the spring crops were scarce, the cost of cartage from the store would have to be added to the market price, particularly in districts relying wholly upon spring crops, whereas in seasons when the spring crops were plentiful and in excess of the farmer's own requirements, the cost of cartage to the nearest railway station would frequently have to be set off against the market prices ruling. On this basis the following prices have been adopted for the valuation of the crop on the Station farm.*

	Grain per ton	Straw per ton
1921	£12	£3 10s. 0d.
1922	£10	£3 0s. 0d.
1923	£10	£2 0s. 0d.
1924	£10	£2 0s. 0d.
1925	£12	£3 10s. 0d.

In Table V, the autumn and spring varieties have been compared for each of the five years, the yields having been

* The figures have been based on a careful study year by year of the prices ruling at valuations in the district.

converted to monetary value per acre on the scale of prices noted above.

TABLE V.—TO SHOW THE VALUE PER ACRE OF THE OAT CROPS GROWN AT THE STATION.

	Grey Winter			Black Winter			Record			Radnorshire Sprig		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1921 . ..	31	17	0	27	17	0	10	12	0	13	19	0
1922	20	1	0	21	1	0	19	11	0	19	16	0
1923*	3	19	0	4	11	0	6	19	0	6	0	0
1924	14	15	0	14	19	0	13	7	0	14	4	0
1925	15	4	0	15	3	0	13	9	0	11	9	0
Total value per acre for 5 years	£85	16	0	£83	11	0	£63	18	0	£65	8	0

These figures show fairly clearly the enhanced value of varieties which crop heavily during seasons when the main crop suffers from adverse weather conditions; and it is in this respect that the autumn-sown winter varieties would appear to be of such particular importance. It is also interesting to note that, for the five-year period as a whole, the advantage has been with the winter varieties.

In order to cater for the vagaries of the weather, therefore, the practice of sowing winter oats on a portion of the oat breadth is presumably to be recommended in many districts, even like that near Aberystwyth, where all the farmers at present rely wholly upon spring oats. Winter oats are, furthermore, often found suitable on fields liable to attack by wireworm or the fritfly. If spring oats be sown early and the weather should turn cold when the young plants are in the two- or three-leaf stage, their growth may be checked and they will remain for a comparatively long period in that stage, when wireworm frequently do considerable damage. On the other hand, if spring oats are sown late on such fields they are very liable to attack by the fritfly.

Comparison of Winter Varieties.—From Table V it will be seen that, on soil of moderate fertility, both Grey Winter and Black Winter oats were sufficiently hardy to withstand the winter conditions, even on very exposed situations. On a very poor soil, however, as in 1923, they were unable to thrive properly in the spring, but had the trial for that year been manured, it is more than probable that the autumn-

* The yields in this trial were much below the average for the season, due to the extra poor condition of the soil in regard to plant food. The spring-sown crops were generally heavy in this season.

sown varieties would have compared much more favourably with the spring-sown varieties.

Marvellous did not prove sufficiently hardy to withstand the considerable exposure even in the mild winter of 1921-22, although grown on moderately good soil. Most of the plants succumbed with the first touch of frost and, though the surviving plants recuperated very quickly with the advent of higher temperatures in the spring, the crop remained exceedingly thin on the plots. In 1924-25 also, about three-quarters of the plants perished at the beginning of January, whilst the surviving plants in this case again picked up very quickly in the spring, but failed to tiller at all, probably owing to the poorness of the soil. This variety, however, is known to have done well on better quality soils in more sheltered situations, where its strong straw serves admirably to withstand lodging, and where it is able to tiller to a slight extent; but the crop usually has a tendency to be rather thin, and it is not, therefore, a variety that can readily recover from considerable winter-killing.

LIVE STOCK IMPROVEMENT SCHEME

REPORT FOR THE YEAR ENDED MARCH 31, 1926

IT is somewhat difficult to summarise the operations of the Ministry's Live Stock Improvement Scheme without a repetition of much that has already been said in regard to previous years. This is due very largely to the circumstance that the scheme is not a venture in experimental research in which new results can be tabulated as the investigation progresses. The scheme was initiated rather as an exposition of the already proved principles upon which the live stock of the country can be graded up. These principles may be briefly summarised as (1) careful selection in mating, (2) suitable feeding, (3) care and cleanliness in management, and (4) knowledge, in regard to cows, of the milk-yielding capacities of each animal. While the beneficial results which follow from the application of these methods to the breeding of live stock may require no further proof, it is still unfortunately a fact that very many farmers do not realise that these results are within their reach, or can be brought within their reach, by the aid of the Ministry's Live Stock Scheme.

Apart from an element of conservatism in the disposition of many farmers, the question of expense acts as a strong

deterrent to the adoption of the methods necessary to improve the quality of live stock. Good sires, normally, are somewhat expensive, and milk recording involves a small initial outlay—even if undertaken privately. Moreover, sound advice in feeding and management is not always available. Since it was inaugurated in 1914 the Ministry's scheme has pursued its primary object of overcoming the prejudice or indifference of those farmers who have been reluctant to incur the expense or undertake the trouble which is inseparable from breeding on the above lines. Provision is made for the location throughout the country of approved pedigree sires whose progeny will, in due course, afford convincing proof of the commercial value of good parentage. Each approved sire, so located, not only brings the means of proper mating, at a moderate fee, within reach of small breeders in a district, but also becomes in effect a local demonstration, whose work for the improvement of the live stock of the district is reflected eventually in the local show and sale ring.

A further, and equally important, provision made under the scheme is that which encourages owners of dairy herds to keep records of the milk yields of each individual cow with the object of eliminating animals which are proved to be making an unprofitable return for the cost of their keep. Owners who keep such records are enabled, through the medium of their local milk recording society, to have them independently checked. Such records, in addition to providing the knowledge which enables unprofitable cows to be weeded out, enhance the commercial value of the high-yielding cows. The Ministry anticipated that, as these results became evident, the interest of farmers would be stimulated in regard to such questions as rationing, testing for butterfat, etc. The progress which the scheme has made has justified this anticipation. The services and advice of the Ministry's Live Stock Officers, and of the County Organisers, are being increasingly sought in connection with these matters, and it is this development which shows, more than any array of figures, the true value and progress of the scheme.

Bulls.—The total number of bulls actually located for service during the year ended March 31, 1926 (*i.e.*, continued from the previous year with renewed grants, or provided for fresh districts during the year), was 1,175, an increase of 106 on the preceding year.

BULL SCHEME

SHOWING THE NUMBER OF BULLS SUBSIDISED EACH YEAR SINCE THE COMMENCEMENT OF THE SCHEME

Year April 1—March 31	Societies	Individuals	Total Number of Bulls
1914-15*	369	43	497
1915-16	489	28	633
1916-17	543	15	659
1917-18	578	14	710
1918-19	604	7	721
1919-20	568	6	675
1920-21	561	6	668
1921-22	726	3	847
1922-23	831	1	947
1923-24	840	1	978
1924-25	916	1	1,069
1925-26	1,026	1	1,175

* Including the period February 1, 1914, to March 31, 1914.

It is satisfactory that, notwithstanding the unfortunate necessity for reviving movement restrictions in many districts, on account of foot-and-mouth disease, substantial progress was made in the location of premium bulls in new districts. While these restrictions have prevented the fullest use of premium bulls, they have indirectly furnished evidence of the influence of the bull scheme in districts where it has been fairly tried. One result of the restrictions on the movement of cows has been an increase in the purchase of bulls by farmers for use on their herds ; and the Ministry has reason to believe that in some such cases these farmers have acquired good bulls as the outcome of their previous experience of the use of premium bulls. There are still, of course, many districts where little good can be achieved by the introduction of premium bulls. In areas where milk production is the all-absorbing interest, and where no thought is given to the quality of the calves—of which very few are reared—it is extremely difficult to demonstrate the value of good sires. In rearing districts, however, where progeny is a consideration of importance, there has been, during the past few years, in the opinion of those able to judge, a marked change in the attitude of farmers towards the question of rearing—a change which is based on the evident improvement of the live stock brought about by the scheme.

Probably the best index of this improvement is the quality of stock exhibited in competitive shows and in the open market, and the Ministry has ample evidence of the growing recognition of the outstanding merits of Scheme animals. In Yorkshire, for example, the first prizes at seven local shows were taken by premium bulls. At Holsworthy (Devon) Show a class of premium bulls provided the champion beast in the show ;

and these bulls won three first, three second, two third and two fourth prizes in other classes. It is significant that the provision of separate classes for premium sires and their progeny is increasing in favour. The Yorkshire Agricultural Society again made arrangements for a class for premium bulls, and the Bakewell Farmers' Club repeated its Group Class for premium bulls with two each of their progeny. A Class for premium bulls was arranged by the Royal Lancashire Agricultural Society at Lancaster for the first time, and in view of the success of the experiment the arrangements are being repeated for the Society's Show at Burnley during the current season. Classes for premium bulls have also been arranged at Holsworthy (Devon), at Louth (Lincs), and also at the Durham County Agricultural Show.

These classes for premium bulls serve a very useful purpose in advertising the scheme, but their value as an educational agent would, in the Ministry's opinion, be enhanced, if the classes were more generally extended to include the progeny of the sires exhibited. The tendency appears, however, to be in that direction, and signs are not wanting to show that the scheme is continuing to create a definite interest in good breeding. An interesting illustration of this has been provided by the formation, in the Peak District of Derbyshire, of a Breeders' Association, comprised chiefly of farmers interested in and using sires under the Live Stock Scheme. Since the formation of this Association, thirty farmers have commenced grading up their non-pedigree stock into Coates' Herd Book.

The process of education on the above lines must necessarily be a slow one, and it is an open question whether the activities of the bull scheme should not be reinforced by legislation in regard to scrub bulls to which reference was made in last year's Report. The Ministry has expressed its readiness to proceed with such legislation as soon as it is satisfied that sufficient agricultural support is forthcoming. There has, however, been a certain amount of opposition which, the Ministry has reason to believe, is based upon a misconception of its proposals. In districts where the object and *modus operandi* of the proposed legislation are fully understood there has been a large measure of support, which may eventually lead to general acceptance of the proposals as both necessary and expedient. In the meantime the Ministry has the matter under constant review. It is worthy of mention as a tribute to the value of the bull scheme that in several cases where opposition to the proposed legislation has been expressed it has been

coupled with an urgent desire for the extension of the scheme. This, however, is not the solution of the scrub-bull problem, as the Live Stock Scheme cannot operate successfully, in those districts where the production of milk is the sole consideration, so long as owners of dairy herds regard the bull merely as the means of flushing the cows and the calf as a necessary evil to be disposed of at the first market after it is dropped. Moreover, the scheme is not intended to provide bulls for large herds, and it is in these large herds in dairy districts that bad bulls are so often used.

It must be borne in mind, also, that this country may become the dumping ground for young bulls from Ireland, which are exported if not likely to be passed in that country under the licensing schemes which now operate in the Irish Free State and Northern Ireland.

Prices.—There was very little difference in the average price of all the bulls used under the scheme as compared with the previous year. In the case of British-Friesians, Lincoln Reds, and South Devons there was an appreciable increase in the average price, but in other breeds there was a compensating decrease. The following table shows that the Shorthorn breed continues to supply more than half the sires subsidised during the year, and that the proportion of Devon, Hereford, and Lincoln Red Breeds was well maintained.

NUMBERS AND PRICES OF BULLS OF EACH BREED

Breed	1914–15				1924–25				1925–26			
	No.	Average Cost			No.	Average Cost			No.	Average Cost		
		£	s.	d.		£	s.	d.		£	s.	d.
Aberdeen-Angus	—	--			1	52	10	0	1	52	10	0
British-Friesian	16	—			6	53	14	0	3	58	8	4
Devon ..	16	40	17	6	115	58	11	0	128	55	6	11
Guernsey	—	—			13	47	13	0	13	48	0	0
Hereford ..	63	33	7	6	105	50	2	0	121	48	3	9
Lincoln Red	33	31	10	0	116	51	19	0	132	59	0	7
Red Poll ..	–	—			2	28	0	0	1	21	0	0
Shorthorn	337	37	17	0	593	55	5	0	644	55	4	3
South Devon	6	36	11	6	11	38	13	0	14	43	16	8
Sussex ..	—	—			1	44	2	0	1	44	2	0
Welsh Black	35	29	9	0	63	47	6	0	67	43	18	6
All breeds	497*	£36	0	0	1026	£53	18	0	1125†	£53	19	9

* Including 7 "other breeds."

† 1,175 bulls were located, but grants in respect of 50 were in suspense at the end of the year.

Service Fees.—The service fees also varied little from the previous year. About one-half of the bulls served at a fee of 5s., and the average service fee for all the bulls was 5s. 2d., practically the same as in the preceding year.

Year	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6
1914–15	265	57	41	42	3	88		—	—
1924–25	54	46	21	78	7	539	4	95	3
1925–26	55	50	25	74	13	616	5	108	2

Year	7/-	7/6	8/	8/6	9/-	9/6	10/-	Over 10/-
1914–15	—	1	–			–	—	
1924–25	8	135	6	8	1		15	6
1925–26	8	140	4	5	1	1	15	3

Boars.—The number of boars available during the year ended March 31, 1926 (*i.e.*, continued from the previous year with renewed grants or located in fresh districts during the year), was 710. As the following table shows, this figure represents an appreciable advance upon the preceding year.

BOAR SCHEME

SHOWING THE NUMBER OF BOARS SUBSIDISED EACH YEAR SINCE THE COMMENCEMENT OF THE SCHEME

Year April 1 to March 31	Societies	Individuals	Total Number of Boars
1914–15*	115		115
1915–16	180		193
1916–17	186	15	216
1917–18	172	92	264
1918–19	156	167	350
1919–20	120	225	399
1920–21	135	285	441
1921–22	113	416	550
1922–23	93	451	569
1923–24	78	541	638
1924–25	68	587	655
1925–26	57	649	710

* Including the period February 1, 1914, to March 31, 1914.

It is unfortunate that the increase in the number of boars located under the scheme cannot be regarded as indicating a steady improvement in the state of the pig-breeding industry as a whole. In most districts, the fluctuations which have characterised the industry for so many years continued to operate adversely during the year. A slump in prices was followed by a reduction in the number of breeding sows, and a further depletion of stocks was caused by the sale of fat sows so soon as prices began to revive. The consequent scarcity of breeding sows has prevented the location of boars in many districts. It is satisfactory, however, that in some districts where the in-

dustry has been more established by the existence of a steady demand, such as a bacon factory, and where more consistency in the type of pig produced is shown, good progress has been made.

Prices.—The popularity of the White breeds, particularly the Large White, is again shown by the following table. The marked decline in the number of Large Black and Gloucester Old Spot pigs shown in last year's report was further continued in 1925-26. This may be attributed partly to the substitution, in Wales and Cornwall, of Welsh and Long White Lop Eared pigs, following on the recent recognition of these breeds by the Ministry.

NUMBERS AND AVERAGE PRICES OF BOARS OF EACH BREED

Breed	1914–15 No.	1914–15 Average Price £	s.	d.	1924–25 No.	1924–25 Average Price £	s.	d.	1925–26 No.	1925–26 Average Price £	s.	d.
Berkshire ..	10	8	0	0	15	13	3	5	15	13	5	2
Cumberland					33	12	9	4	41	12	0	11
Essex ..					4	18	2	9	1	25	4	0
Glos. Old Spot	7	7	1	0	22	14	18	3	9	16	2	11
Large Black	18	7	5	6	103	12	1	2	70	11	11	10
Large White	64	7	3	0	247	13	16	10	315	13	12	4
Lincoln Curly Coat	4	8	4	6	27	10	17	11	35	9	19	6
Middle White	12	6	17	0	111	14	5	0	105	13	0	9
Large White Ulster					7	15	19	3	6	14	16	8
Tamworth ..					2	18	2	0	2	14	8	6
Wessex Saddleback					22	13	5	7	21	12	19	7
Welsh ..					24	11	16	1	41	12	3	4
Long White Lop Eared							--		7	13	4	8
All breeds	115	£7	5	3	617	£13	8	1	668*	£12	19	5

* 710 boars were located, but grants in respect of 42 were in suspense at the end of the year.

Service Fees.—The service fees, ranging from 2s. 6d. to 10s., varied very little from the previous year. More than one-half of the boars served at a fee of 5s., and the average fee for all the boars was 5s. 3d., practically the same as last year.

Year	2/–	2/6	3/	3/6	4/–	4/6	5/	5/6
1914–15 ..	21	62	10	5	6	--	2	—
1924–25 ..	—	9	10	14	45	4	371	2
1925–26 ..	--	8	11	20	57	3	414	1

Year	6/–	6/6	7/–	7/6	8/–	8/6	10/–
1914–15 ..	—	—	—	—	—	—	—
1924–25 ..	52	3	2	100	—	1	4
1925–26 ..	53	3	—	91	—	1	6

Heavy Horses.—From the annual returns furnished to the Ministry it would appear that the decline in the breeding of horses to which reference was made in last year's report has continued. It is the more satisfactory therefore to note from the following table that further appreciable recovery has been made as regards the operations of the Ministry's Heavy Horse Scheme which was revived in the season of 1924.

HEAVY HORSE SCHEME

Year	No of stallions	†Total No of mares served	†Average No of mares served	No of assisted nominations	Average hiring fee of stallions	Average service fee		
					£	£	s	d
1914–15	72	6,365	68	1,503	231	2	8	6
1915–16	97	9,122	94	2,430	241	2	9	6
1916–17	108	9,995	92	2,181	244	2	11	0
1917–18	110	10,556	96	2,151	258	2	16	3
1918–19	122	12,281	100	2,165	285	2	15	8
1919–20	118	10,920	96	1,996	317	3	6	3
1920–21	105	9,133	87	1,839	345	3	13	1
1921–22	101	7,888	78	1,943	333	3	13	7
1924–25	87	6,098	70	–*	178	2	7	0
1925–26	96	7,413	77	1,723	194	2	8	4

* No grant was made by the Ministry for assisted nominations (except to the Cumberland Society) for the year 1924–25.

† Excluding the Cumberland and Westmorland Heavy Horse Society, which was formed in 1916 for the purpose of issuing only assisted nominations to selected stallions The figures for this Society were as follows —

Year	Number of Assisted Nominations	Year	Number of Assisted Nominations
1915–16	385	1920–21	254
1916–17	394	1921–22	255
1917–18	328	1924–25	121
1918–19	321	1925–26	197
1919–20	264		

The decline in the number of assisted nominations, issued by this Society, is due to the increased service fees which automatically increased the value of an assisted nomination and, consequently, reduced the number available from the Ministry's grant. For 1924–25 the Ministry's grant was reduced to one-half the amount given in previous years, hence the further decrease in the number of nominations issued during that year.

As was anticipated the revival of assisted nominations has led to an increase in the average number of mares served. It has been difficult in some districts to revive the operations of societies which ceased owing to the withdrawal of financial assistance, but this is being accomplished in many cases and there is every reason to hope that the scheme will fully justify

its revival by useful work. In some instances Live Stock Officers have been able to report the opening up of new districts where a start has been made with every promise of success.

Horse Breeding Act, 1918.—There was a further marked decline in the number of stallions licensed during the year ended October 31, 1925, although it may be observed from the figures given below that the rate of decrease was rather less heavy than in the two preceding years.

Year (ending October 31)	Number of Applications for Licences	Number of Licences Issued	Number of Refusals
1920	4,153	3,749	404
1921	4,060	3,816	244
1922	3,644	3,479	165
1923	2,897	2,761	136
1924	2,285	2,210	75
1925	1,908	1,849	59

Of the 1.849 stallions licensed in 1925, 1,710 were pedigree animals and the remaining 139 were horses that were not entered or accepted for entry in any recognised stud book.

The following tables show the number of stallions of each breed concerned that were licensed or rejected, and the number refused licences in respect of the various prescribed diseases or defects :—

NUMBER OF STALLIONS LICENSED OR REFUSED

	Pedigree		Non-Pedigree*	
Heavy	Licensed	Refused	Licensed	Refused
Shire	918	32	35	1
Clydesdale	125	2	4	–
Suffolk	146	3	1	
Percheron	47	2	–	–
Others			27	1
Light				
Hackney	133	4	18	1
Thoroughbred	152	10		
Arab	15	1	2	
Hunter	5		3	
Cleveland Bay	6		1	
Yorkshire Coach	3			
Welsh Roadster	2		1	
American Trotter			5	1
Others		–	6	–
Ponies (including Welsh Cobs)	158		36	1
TOTALS	1,710	54	139	

* Non-pedigree stallions are arranged as far as possible under types.

NUMBER OF STALLIONS REJECTED FOR THE PRESCRIBED DISEASES AND DEFECTS

Roaring	11	Defective Genital Organs	2
Whistling	20	Stringhalt	5
Sidebone	6	Shivering	3
Cataract	6	General Unsuitability ..	—
Ringbone	2		—
Bone Spavin	4	TOTAL	59

Twelve appeals were made against refusals of licences, and in eight cases the appeal was successful.

Notwithstanding the somewhat serious position of the horse breeding industry it is satisfactory to note that the main object of the Horse Breeding Act—the elimination of the unsound travelling stallion—is being achieved in a very large measure. During the licensing year under review only two unlicensed stallions were reported on the road, and in both cases proceedings were instituted by the Police and resulted in convictions. Six licensed stallions were reported as travelling unaccompanied by licences: and in two of these cases the grooms in charge were prosecuted.

Sheep.—The financial assistance which the Ministry has given since 1919 towards the improvement of Welsh Mountain Sheep was continued during 1925-26. Grants, up to a maximum of £10 for each ram provided, at the rate of 3s. 4d. per ewe served, were made to twenty-two societies in respect of twenty-five approved pedigree rams. The average hiring fee of the rams was £9 8s. 6d., and the average service fee 1s. 7d. The number of ewes served was 1,498, an average of 60 per ram.

Great interest is shown by the societies, many of which hold small shows of their own or provide classes at larger shows for the exhibition of lambs. This section of the Live Stock Scheme has been the means of inducing an increasing number of farmers to acquire pedigree rams for use on their hill flocks.

As an illustration of the practical benefit of the scheme it may be mentioned that the highest priced ram at the 1925 Aberystwyth Show, viz., 39 guineas, was sired by a scheme ram, his dam being also by a scheme ram.

Milk Recording.—The steady progress which the Milk Recording Scheme has made since its commencement in 1914 was well maintained during the milk recording year ended October 1, 1925. The following table indicates this progress

as far as it can be shown by the increase in the number of members and herds :—

	Year*	Societies	Members	Herds	Cows
April 1 to March 31	1914–15	16	264	306	7,331
	1915–16	20	350	398	9,811
	1916–17	22	441	495	12,950
	1917–18	25	503	555	14,404
October 1 to September 30	1917–18	27	639	708	19,793
	1918–19	38	1,191	1,332	37,880
	1919–20	46	2,075	2,312	61,323
	1920–21	52	3,328	3,664	97,903
	1921–22	55	3,949	4,362	117,023
	1922–23	55	4,365	4,767	127,151
	1923–24	52†	4,764	5,209	138,086
	1924–25	50†	5,081	5.516	148,905

* Before October 1, 1917, there was no uniform year for societies.

† The decrease in the number of societies is due to amalgamation.

The real nature of the development of the milk recording scheme cannot adequately be expressed in figures. It is indicated not only by the steady increase in the number of members but also by the improvement which has undoubtedly taken place in the manner in which records are being kept, and by the interest which members are taking in such matters as butterfat tests and rationing. Another feature which is worthy of notice is the increasing stability of the societies operating under the scheme. While there are exceptions which leave much to be desired there are a number of societies which are now well established and which conduct their operations with commendable keenness and efficiency. The handbooks issued annually by several societies and containing not only particulars of the year's operations, but also a number of articles upon subjects of practical interest to their members, afford pleasing testimony to the manner in which the milk recording movement is making headway.

Average Yield of Herds Recorded.—The annual returns furnished by the fifty societies for the recording year ended October 1, 1925, show that of the 148,905 cows and heifers recorded, 51 per cent. were cows which had been retained in the herds for the full year, and that the average yield of these 77,132 cows was approximately 6,925·5 lb. The following table compares the average annual yield of (1) all cows and heifers recorded, and (2) the cows recorded for the full year for each year since the uniform milk recording year was fixed.

Year October 1 to October 1	No. of Societies	Particulars of all cows and heifers recorded			Particulars of cows recorded for full year			
		No. of cows and heifers	Total yield	Av. yield	No. of cows	Percentage of total cows and heifers	Total yield	Av. yield
			gal.	gal.			gal.	gal.
1917–18..	27	19,793	8,426,958	426	8,775	44	5,255,923	599
1918–19..	38	37,880	16,204,941	450	17,989	47	10,543,516	579
1919–20..	46	61,323	29,344,887	479	27,266	44	17,363,347	637
1920–21..	52	97,903	48,512,380	495	48,248	49	30,892,620	640
1921–22..	55	117,023	60,463,617	517	63,318	54	41,208,073	651
1922–23..	55	127,151	67,904,224	534	68,349	54	46,956,565	687
1923–24..	52	138,086	73,963,165	535	73,338	53	50,299,884	685
1924–25..	50	148,905	76,419,498	513	77,132	51	51,695,291	670

It will be seen that the average of full-year cows shows a reduction of approximately 15 gallons as compared with the preceding year. The actual decrease, however, was somewhat less than this amount, for the reason that the average for 1924-25 has been calculated on the equivalent of 10⅓ lb. to a gallon, whereas in former years the equivalent adopted was 10¼ lb. The reduction in the average yield appears to have been general throughout England and Wales, although eleven societies showed an increase. Where so many factors have an effect on milk yield it is difficult to assign a satisfactory explanation of this general reduction, but it is generally attributed to the drought during the summer. In cases where the average yield of a herd has been increased it is reasonable to suppose either that the adverse influences have been less active in the district, or that more care and intelligence in management have been displayed by the owner. A few examples of the increase which has been effected in the average yield of herds and of the financial benefit involved are given in the table on the next page.

Milk Record Certificates.—There was again a considerable decrease in the number of certificates issued, only 353 being issued as compared with 633 for the preceding year. The explanation is no doubt that the purposes for which certificates of milk record were formerly required no longer exist. A certificate is not now necessary as a condition of entry in the Ministry's Register. On the other hand it is very satisfactory to note that there was a substantial increase in the number of certificates of merit issued in respect of the year under notice. These certificates are of value inasmuch as they certify both

Herd	No. of years during which records were taken	Av. yield per cow in first year	Av. yield per cow in last year	Increase in annual average yield per cow	No. of cows in last year of period	Cash value of Incr. of last year over first year at 1s per gallon: Per cow	Per herd
		gal.	gal.	gal.		£ s.	£ s.
A. (Non-pedigree Friesian) .	6	551	1,048	497	14	24 17	347 18
B. (Non-pedigree Shorthorn)	5	388	788	400	10	20 0	200 0
C. (Non-pedigree Shorthorn) .	6	615	909	294	37	14 14	543 18
D. (Pedigree Shorthorn)	5	383	771	388	14	19 8	271 12
E. (Non-pedigree Shorthorn)	6	512	847	335	11	16 15	184 15
F. (Pedigree Shorthorn)	6	584	896	312	18	15 12	280 16
G. (Pedigree Park Cattle) .		479	725	246	13	12 6	159 18

milk yielding and breeding abilities of a cow for a period of three consecutive years. 197 such certificates were issued as compared with 83 in the previous year.

Of 191 cows which were so certified for the three years ending October 1, 1925, 72 (including 42 Shorthorn, 16 Friesian, 4 Red Poll, and 3 Guernseys) yielded over 30,000 lb. during the three years. The highest yield, viz., 58,863 lb., was given by a non-pedigree Shorthorn cow. A pedigree Shorthorn cow gave 47,313¼ lb. and a pedigree Friesian cow gave 46,747 lb.

Register of Dairy Cattle.—Certain changes in the formation of the Ministry's Annual Register of Dairy Cattle which were made with the object of increasing its size and usefulness were set out in last year's Report and incorporated in Volume 8. It has been found possible further to increase the size of the Register to include not fewer than 7,500 cows, and Volume 9, which will be issued shortly, contains this number of the highest yielding cows selected from the Annual Returns of the various Societies. Nineteen recognised breeds or types are represented in the volume, 65 per cent. being of the Shorthorn type 18 per cent. Friesian, and 3 per cent. Guernseys.

Although the Register is limited to 7,500 entries there were nearly 12,500 cows under the scheme which qualified for entry under the prescribed standards of yield, the lowest of which is 8,000 lb. for the year. It is not surprising, therefore, to find that practically all the cows entered have yielded 9,000 lb. or

over in the year; 57 per cent. yielded between 10,000 and 12,000 lb., 15 per cent. between 12,000 and 14,000 lb., and 5 per cent. between 14,000 and 20,000 lb. Twelve cows gave 20,000 lb. or over. Particulars of the cows for which certificates of merit were issued are also included in the volume.

There was a noticeable increase in the number of bulls entered in Volume 9. The condition upon which a bull may be entered in the Register is either (*a*) that its dam and sire's dam have given not less than the standard yield prescribed for their breed or type in any particular milk-recording year, or (*b*) that it has two or more daughters which have given not less than the standard yield prescribed for their breed or type in any particular milk-recording year. There are thirty-eight entries in Volume 9, of which twenty-five qualified under condition (*a*) and thirteen under condition (*b*).

Competitions.—It is inevitable in any movement which has for its object the improvement of separate but affiliated units, that an element of competition must enter sooner or later into the proceedings, and it is not surprising therefore that there has been during the year an increased activity in the arrangement of herd competitions and clean milk competitions. This movement has been encouraged by a number of keen supporters who have provided many substantial prizes both for local and national competitions. Apart from the fact that these competitions prove a notable advance in education on the part of a large number of dairy farmers, the improvement which must inevitably follow in the management of the herds of those who participate, is a factor of considerable importance.

Rationing.—The increasing interest taken in the economic feeding of a dairy herd is a natural development of the Milk Recording Scheme; and advice on rationing is being sought by farmers with increasing keenness. Advice and assistance is given chiefly by the County Agricultural Organisers. An interesting result of the movement is that a number of owners of dairy herds have started to record privately in order to avail themselves of the benefits of a local rationing scheme.

Testing for Butter Fat.—Butterfat testing is receiving increasing attention among the various milk recording societies. During the year ended October 1, 1925, over 95,000 samples were taken and analysed as compared with 72,000 in the previous year, and over 79,000 of these samples were from the milk of individual cows. This increase is, no doubt, partly due to the action of certain breed societies which require evidence of

quality as well as quantity in regard to cows registered in their Herd Books. The Ministry has frequently been urged to formulate a uniform scheme for butterfat testing with a view to official recognition of such tests. While fully agreeing with the desirability of improving the quality as well as the quantity of milk produced, the difficulties in the way of securing absolutely and uniformly reliable sampling are such as to make official recognition impracticable at the present time. This fact, however, in the opinion of the Ministry, in no way diminishes the advantage to be gained by an owner who is sufficiently keen and enlightened to take butterfat tests for his own information.

Calf and Bull Marking.—15,416 calves and 117 bulls were marked under the scheme as compared with 14,248 and 114 respectively for the preceding year.

Cost of Milk Recording.—There was a further, though very slight decrease in the cost of recording during the year both as regards the average cost per cow to the member and to the Society, which was 4s. 3d. and 6s. 3d. respectively. While it is improbable that the cost of recording can be reduced much further, it cannot, in view of the advantages gained, be regarded as excessive, except in the case of the owners of small herds who are called upon to pay a minimum fee.

Export of Live Stock within the Empire and to Foreign Countries.—The export of live stock to foreign countries and colonies has been much restricted on account of the temporary measures prohibiting importation which have been passed by the various governments in view of the outbreaks of foot-and-mouth disease in this country. The Ministry is kept informed of any alterations, temporary or otherwise, in the regulations of the various countries, and is able to furnish particulars to intending exporters who, in order to avoid delay and expense, should be careful to inquire before making any arrangements. It may be of interest to regular exporters to know that a complete summary of the importation regulations of foreign countries and colonies may be obtained from the Ministry on payment of 10s., and purchasers of this summary are informed of alterations or amendments as they are notified to the Ministry.

Particulars of the number and declared value of animals exported to colonies and foreign countries are published at the

STATEMENT GIVING PARTICULARS OF FIFTY MILK RECORDING SOCIETIES OPERATING DURING THE YEAR ENDED OCTOBER 1, 1925

(The Societies are arranged in order of total number of animals recorded)

Society	*No. of members	*No of herds	*Total No of animals recorded	*Number of cows recorded for full year	*Average yield of cows recorded for full year
					lb.
Somerset and North Dorset	275	304	9,368	5,294	6,782 6
Essex	232	259	9,178	4,818	7,482 7
Hampshire	235	259	8,382	4,720	6,859 4
East Sussex	202	233	6,894	3,469	6,785 1
Berkshire ..	153	175	6,326	3,295	6,771 0
North-West Wilts	122	145	6,221	3,556	6,870 4
Norfolk	210	235	5,835	3,042	7,523 6
Kent	190	209	5,779	2,860	6,992 5
Hertford	172	196	5,611	2,834	6,868 4
Dorset	90	117	5,096	3,085	6,540 9
Surrey	181	194	4,995	2,348	6,729 8
West Sussex	125	144	4,437	2,304	7,060 5
South Wiltshire	79	101	4,223	2,587	7,545 3
Oxford	120	130	4,042	2,068	6,980 6
Warwick	150	154	3,767	1,763	7,193 1
Leicester	134	143	3,684	1,868	6,968 3
Suffolk	154	165	3,616	2,140	7,323 1
Lancashire	112	113	3,434	1,243	6,386 7
Shropshire	79	86	2,778	1,577	7,334 3
Northants	103	111	2,621	1,243	6,387 3
Stafford	88	92	2,581	1,313	7,417 7
South Devon	116	120	2,552	1,134	5,831 6
Yorkshire	128	137	2,350	1,144	7,170 6
Cambridge	88	95	2,319	1,163	7,520 9
Derby	56	62	2,197	938	7,382 1
Cheshire	61	63	2,153	919	6,725 0
Bucks .	79	82	2,023	1,035	7,012 2
Cumberland and N Westmorland	124	125	1,961	880	5,861 2
Gloucester .	80	85	1,813	971	7,226 0
Nottingham	53	56	1,790	722	7,025 2
Worcester	79	83	1,769	860	7,215 4
Bristol and Bath	76	77	1,747	866	7,098 5
Denbigh and Flint	85	86	1,712	927	6,429 5
East Devon	93	93	1,640	833	6,379 4
Bedford	48	52	1,473	733	6,902 9
Peak (Derby)	65	65	1,269	555	7,278·3
Lincoln .	41	45	1,141	583	6,890 2
Cornwall ..	63	63	1 054	563	6.097 8
United Counties	75	77	1.038	541	6,131 7
Herefordshire	38	39	967	492	7,175 1
Kendal and S Westmorland	47	49	951	398	6,078 6
Anglesey and Carnarvon	85	86	888	564	5,463·7
Tees Valley	25	31	874	393	6,754 6
Campden Moreton	39	40	867	491	6,568 2
North Somerset	38	40	840	532	6,703·3
Monmouth ..	34	36	704	314	6,714 9
Allendale .. .	31	32	606	355	6,821·2
Melton Mowbray	29	30	514	270	6,389·2
Glamorgan .. .	48	48	494	371	6,557·7
Montgomery .	24	24	331	138	6,628·1
	5,054*	5,486*	148,905*	77,132*	6,925·5*

* Goats are not included.

end of each quarter in the monthly JOURNAL OF THE MINISTRY OF AGRICULTURE (H.M. Stationery Office, 6d. monthly).

The following are the principal memoranda used in connection with the live stock operations of the Ministry, and single copies of them can be obtained free of charge on application to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1.

Leaflet 282 :	Scheme for Improvement of Live Stock.
Leaflet 146 :	The Value of Records of the Milk Yields of Cows.
No. 609/T.L.:	Bull Grant Regulations.
No. 392/T.L.:	Milk Recording Regulations.
No. 466/T.L.:	Boar Grant Regulations.
No 89/T.L.:	Heavy Horse Regulations

COUNTRY OF ORIGIN OF SEEDS

THE importance of the country of origin of most kinds of agricultural and garden seeds is a matter to which increasing attention is being given, particularly as improved facilities for advertisement and transport and the keen competition for new markets are causing the trade in seeds to become more and more an international business. The Seeds Act is said to have resulted in too much attention being given to the percentage of germination and purity of the seeds sold in this country to the exclusion of the distinct advantages of using home-grown seed. These advantages exist even though, owing to climatic and other conditions, we are unable, in many cases, to produce an article which can compete, as regards purity, germination, and general appearance, with seed grown in countries that enjoy a more suitable climate. When considering the quality of a lot of seeds the farmer is well advised to look to the country of origin in the first place, and to examine the figures as to germination and purity in the light of this information. The requirements of the Seeds Act are of assistance to him in this respect, in that they make it necessary in the case of a sale of any of the principal kinds of grass and clover seed for a statement to be made in writing by the seller declaring *inter alia* the country of origin. Even so, the intricacies of the trade and the difficulties of distinguishing between samples of seed of the same variety obtained from several different sources, sometimes results in parcels of foreign, and possibly very undesirable seed, masquerading either as home-grown or as the produce of a country where

conditions are such that it should be but little less valuable than the home-grown article.

The importance of the country of origin of seed is probably most noticeable in the case of red clover. In this connection Stapledon and Williams say :—*

> "There appears to be no doubt that British strains of biennial red clovers are capable of yielding more hay and aftermath, and of affording more winter keep, than the foreign clovers. For one-year leys English broad red from the Eastern counties is probably the best, but certain broad red clovers from the Western counties, such as the Vale of Clwyd red and Dorset marl, are, by virtue of their greater persisting qualities, more suitable for two-year leys.
>
> "Chilian, New Zealand, and American medium are probably the best foreign clovers for one-year leys, but for two-year leys preference should be given to Canadian and Brittany red clover and to clovers from Bohemia. *Italian clover should never be sown.*
>
> "For stubble and winter grazing broad red grown in the Eastern counties is undoubtedly the best, while Chilian is apparently the best of the foreign clovers."

In order that seedsmen and farmers may be in a position to distinguish the country of origin of both red clover and alfalfa (lucerne) seed, the United States has recently passed a law requiring the staining of all such seed imported into that country. This law, which became effective on May 26, 1926, prohibits the importation into the United States of alfalfa or red clover, or of any mixture of seed containing 10 per cent. or more of either or both of these kinds of seeds, unless it is coloured in such a manner and to such an extent as the Secretary of Agriculture may prescribe. Where practicable the colour used will indicate the country of origin. The law also requires that whenever the Secretary of Agriculture, after a public hearing, determines that seeds of alfalfa or red clover from any foreign country or region are not adapted for general agricultural use in the United States, the importation of such seeds or of mixtures of such seeds into the United States will be prohibited unless at least 10 per cent. of the seeds in each container are stained a red colour in accordance with regulations to be prescribed. The Secretary of Agriculture

* See this JOURNAL, June, 1923, p. 243.

may confiscate any seed which is wilfully misbranded within the meaning of the Act.

It is understood that the first public hearing to be held under this enactment will be to consider whether or not the seed of red clover grown in Italy and seed of alfalfa grown in Africa or in Turkestan are adapted for general agricultural use in the United States.

No particulars have yet been received as to the regulations which will prescribe the colours to be allocated to seed grown in Great Britain or the Continent.

It is probable that one of the intentions of the promoters of the Act is to stimulate the demand for home-grown seed and to discourage the use of imported seed. The question of the adaptability to American conditions of imported red clover seed is one which has been very actively contested for some time, and the confusion resulting from the inaccurate statements that have been circulated in this connection has caused prices of home-grown seeds to rise to such an extent and has raised such doubts in the minds of farmers that they have in many cases refused to plant red clover seed and resorted to substitutes. It is somewhat doubtful whether the staining of imported seed will do very much in the way of lessening this confusion. The United States has for many years relied to a large extent on imported seed to meet its home requirements, and official tests have shown that certain foreign grown seeds yield quite as good crops as those of domestic growth. How will this be affected by the staining laws ? There will be on the one hand farmers who will look with suspicion on all imported seed, even though it be quite adaptable to American conditions, simply because it is stained, and on the other there will be those who appreciate the value of certain foreign seed which will now receive the hall-mark of a distinctive colour, and will refuse to buy any other. The staining regulations may also offer an opportunity to the unscrupulous dealer to pass off poor quality domestic seed as adaptable imported seed merely by staining it with a colour applied to the foreign grown adaptable seed.

The effect this law will have on the price and the supply of red clover and alfalfa seeds in the United States will be of great interest.

Other countries in which laws are in operation requiring the staining or colouring of certain kinds of imported seeds include Australia (lucerne) and Norway and Sweden (certain kinds of grass and clover seed).

THE GREY MOULD OF HOPS

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IN September, 1924, a bed of young hop plants growing in a field on a neighbouring farm, was examined for the incidence of Downy Mildew (*Pseudoperonospora humuli*). This particular fungus was not found on them, though many leaves were seen to have discoloured blotches, greyish in the centre but bordered by a dark purplish brown line and then a yellowish zone gradually merging into the general green of the normal leaf surface. These discoloured spots were mostly $\frac{1}{5}$ to $\frac{1}{2}$ in. in diameter but, in some cases, irregularly-shaped areas, nearly 1 in. in length, were found ; these were probably the result of several spots coalescing. The smaller isolated spots were almost circular. In most cases only one spot was present on a leaf, but sometimes three or four were on the same leaf.

On examining the underside of infected leaves it was found that in every case a fungus was growing out from the diseased spot. A microscopic examination showed the fungus to be *Botrytis cinerea,* a common cause of rot in a variety of plants.

The plants showing the disease had been raised from sets which had been planted the previous year ; they had not yet been transferred to their permanent quarters and were not "trained." The ground was overrun by weeds, and this, together with the persistent wet weather experienced at the time, was probably responsible for conditions that favoured infection by the fungus.

The disease in this particular case was not causing any appreciable damage to the plants apart from the death of the leaf-tissue on the spots, and the degree of infection was obviously due to the unsuitable conditions under which the plants were growing.

Characteristics of Grey Mould Disease.—The same fungus, however, may also occur on the hop cones, when the damage caused is a more serious matter. In September, 1925, several cases came to our notice where hops were turning prematurely brown at the tip. In some instances the Botrytis fructifications were already present and, in every case where a hop showed the characteristic browning, Botrytis fructifications appeared on the brown parts within from one to two days of keeping such hops in moist air. In all the specimens examined it was seen

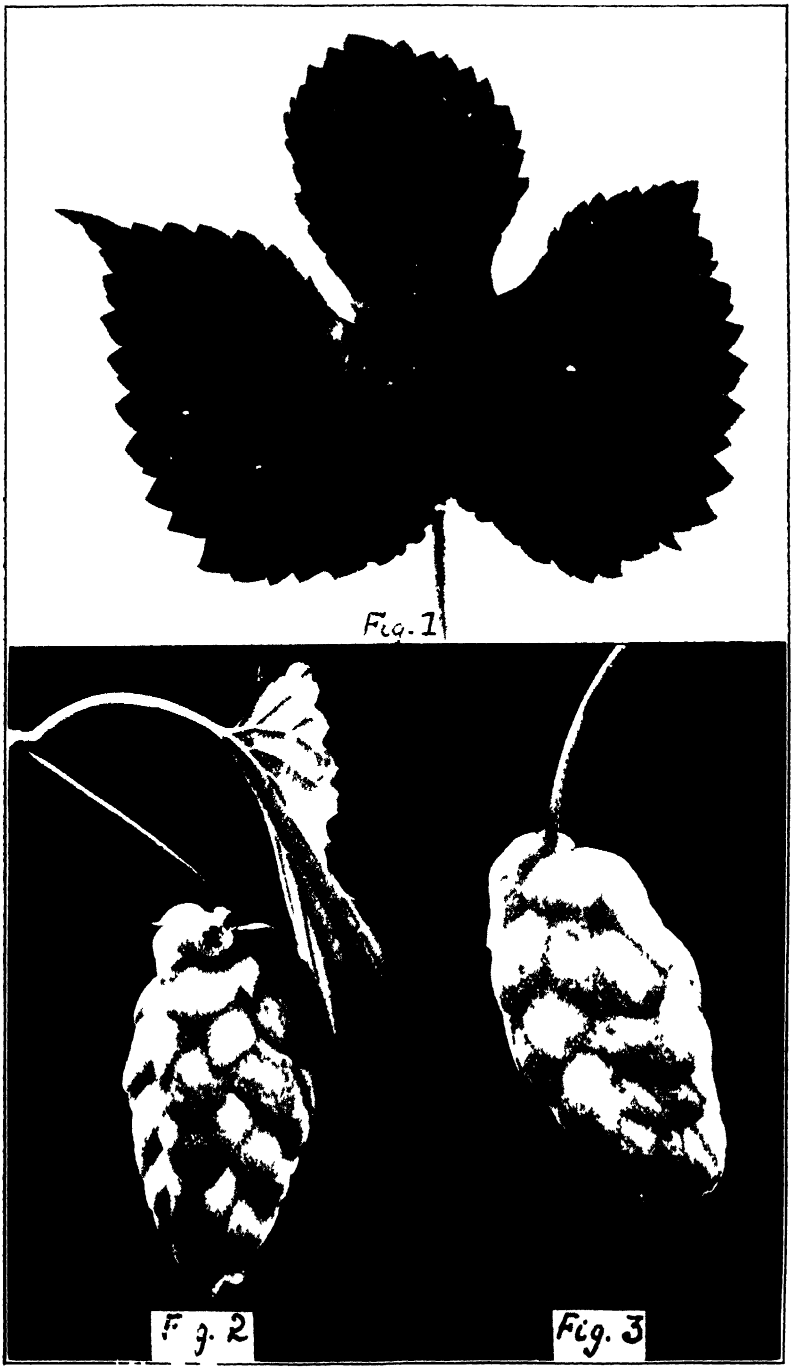

Fig. 1. Hop Leaf showing a *Botrytis* Spot.

Fig. 2. Hop Cone with brown tip; the *Botrytis* fructifications have not yet appeared.

Fig. 3. Hop Cone with brown tip bearing *Botrytis* fructifications.

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that the disease started at the tip of the cone and was extending backwards towards the stalk end. This suggests that drops of rain water or dew accumulate at the top of the cone and act as "infection drops," in which the fungal spores are able to germinate and infect the bracts and bracteoles. In this case the bracts and bracteoles are attacked equally, producing a very distinct brown tip to the cone, and by this effect hops infected with Grey Mould can be distinguished from those attacked by Downy Mildew. In the latter case the disease usually appears (on the cones) on the bracts first, causing the hops to have a striped appearance, and is not confined to the tip.

Up to the present the Grey Mould disease has been seen by us on three varieties, *viz.* : Tutsham, Cobbs and Tolhurst. On the Tutsham variety it was found in four localities—East Malling, Wateringbury, Seal and Chilham. It was plentiful on this variety in three fields at Wateringbury. The worst case of all was on Tutshams trained on pole work.

On a diseased hop which had been kept in a moist atmosphere for about a fortnight the fungus produced a number of sclerotia ; these are dense masses of fungal threads, whitish at first, but later black at the surface. Those found on the hop mentioned were about one-eighth of an inch in length. These sclerotia enable the fungus to survive during unfavourable periods, but, when conditions are again suitable, they give rise to Botrytis fructifications and so serve to disseminate the fungus.

Precautions against Infection.—These sclerotia have not yet been observed by us on hops in the open, but it is highly probable that they develop on infected hops which are left hanging, for *Botrytis cinerea* readily produces such sclerotia in the tissues of any host which it attacks. Brown discoloured hops are often left hanging when the rest are picked. If the browning is caused by a parasitic fungus, as in the present case, it is a bad practice to leave such hops to become overripe and shattered, as the shattered hops carry the fungus to the ground, where it either continues to develop or it remains in a resting stage (in this case in the form of sclerotia) through the winter and may then cause further infection in the following season.

Botrytis cinerea and related species usually require very moist conditions or a moist substratum (such as soft and sappy vegetable tissues) on which to thrive and cause rotting. The

disease mentioned here is not likely to be troublesome except in over-crowded hop-gardens, and in a wet season; but hop growers are advised to take the precaution of preventing the infected hops from shattering, and of having them collected and burnt.

AUGUST ON THE FARM

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Agricultural Organiser for Derbyshire.

Land and Crops.—The eighth month in the Saxon calendar was Arnmonath, meaning barn month, in allusion to this being corn harvest time. That this was looked upon as a period for uninterrupted work may be gathered from the fact that there are comparatively few saint days—formerly occasions for holidays—in the month of August. Until comparatively recent times corn harvest claimed the services of the entire rural population; and in modern farming, although the place of casual village labour has been taken by the mechanical reaper (which leaves little to glean), the farmer cannot emulate the urban employer in relaxing his efforts at this time of the year.

Cutting begins with winter oats, which are often in stook by the end of July. Spring oats, wheat, and barley are usually ripe in the order in which they are here stated a few days before or after the middle of the month; the actual date, however, depends on season, variety, district, and soil. Moderately short-strawed varieties that stand up under heavy rains although well fertilised have a great advantage in wet seasons; but, excepting for late uplands, there is no great advantage in early ripening as a quality favouring good harvesting. The chances of a wet spell about the time of cutting are as great in August as in September, and when August is both wet and hot, the early sorts suffer from sprouting in the ear. For the heaviest yields also a somewhat long growing period is necessary. On the other hand, an early sort may sometimes be cut and secured during a dry period that does not extend beyond the middle of August; early cutting favours the establishment of the maiden seeds, the grazing of which may be very useful; and on heavy land it is worth something to be able to commence stubble cleaning operations a week or two earlier in autumn.

Spring sown roots attain full leaf and root-fibre development during July ; so prepared, they are capable under suitable conditions of making very rapid bulb growth in August. Warmth and moisture are perhaps the dominant factors. In hot dry seasons swede crops, that carry as much leaf as many crops possess at the time of writing, become infested with a grey aphis and the mildew fungus, while mangolds and sugar beet may be attacked by the black aphis. In both cases the attack spreads from centres, and there is no doubt that spraying these patches with a soft soap and nicotine or paraffin emulsion would check the attack if performed early enough. This year many crops of mangolds have been considerably thinned by the depredations of nocturnal pests that have bitten the "roots" through about ground level. There is some evidence that such damage can be reduced by the application of salt in the autumn preceding the sowing of the mangold crop. A dressing of 10 to 20 cwt. of salt has been found to destroy the eggs and larvæ of several insects and slugs, which otherwise would live through the winter and attack spring-sown crops.

Instances of the benefit to be derived from the ploughing-in of a crop of mustard before sowing wheat justify a recommendation for its more general adoption on land that has been bare fallowed or broken up in time for sowing mustard in August. A similar case with winter oats was recorded at Rothamsted in 1924 : an increase in yield of about twenty bushels per acre was obtained as a result of sowing (on a bare fallow) a mustard crop on August 20, 1923, and ploughing it under on October 18, immediately before drilling the oats.

Pasture Land.—Grazing conditions in August are particularly dependent on the weather conditions in July. Sometimes there is a vigorous renewal of bottom growth, whereby the bare brown appearance of the sunny banks is replaced by a spring-like freshness. At other times dry hot conditions persist through the month ; and the opening of the meadow fields gives little relief in the scarcity, for there is equally little aftermath. Diminution of milk yield or the suspension of growing or fattening increase are ordinarily expected under such conditions ; but it is sometimes a matter for wonder how the cattle find even sufficient nutriment for maintenance. What farmers term "baked grass" is evidently very nutritious.

Where live stock have some excess of pasturage, they graze the sward unevenly, preferring such parts of the fields as

produce short leafy herbage and ignoring places where the grass has a tendency to produce bents. Horses are perhaps the worst in this respect; and sometimes suitable fertilisers temporarily emphasise the unevenness of pastures owing to the quicker action of the dressings on the short places. Ordinarily, however, any tendency towards uneven grazing gives the careful grazier concern, as unconsumed patches in pastures are apt to become permanent sour places in the fields; and, on soils deficient in lime, they ultimately become matted, and, while in that state, valueless.

Cause and effect in the above problem—uneven grazing—are not easily separated. Close grazing keeps the herbage young, succulent, palatable, and, as illustrated by the Cambridge results, highly nutritious. From the manner in which cattle detect and bare-off a suitably fertilised plot in a pasture, however, it may be deduced that the closely grazed places in fields are so grazed because of their possessing some inherent attractiveness at the beginning of the season. Uniform consumption therefore depends upon uniform quality of herbage throughout the field.

Where an endeavour is made to provide an abundance of keep and at the same time to maintain the nutritive quality of the grazings, as in the management of feeding land, special care is taken to prevent the development of unevenness, and such attentions as the regular spreading of droppings in the field are regarded as quite indispensable. Indeed, where labour is available the droppings are collected and applied during the winter. In the management of ordinary fair pasture, however, uniform grazing can be promoted by the application of phosphates and potash by hand to those parts of the field that stock reject and allow to seed. Old sour places that have become matted may even require liming. Store stock may, of course, pull off the bents during winter, which is better than leaving the dead forage to accumulate and sour the ground. But to increase the palatability of these areas and ensure better grazing next year, they should receive special manurial treatment that is known to enhance the palatability of herbage.

In this connection the value of mowing rough places in August may be illustrated. At the Hampshire Farm Institute, Sparsholt, there is a pasture of 18 acres which stock do not graze well. For two years in succession, however, half the field has had the mowing machine run over it about the end of August to cut off the unconsumed withered herbage.

This portion now develops a much greater herbage in the autumn, which is much preferred by the stock; indeed, the cattle do not touch the unmown half of the field until the aftermath of the mown portion has been bared off. An improvement in the sward is also obtained.

"Slag and Wild White."—While it cannot be disputed that the tendency to lay down arable land to grass is due to economic conditions, there is no doubt that the virtues of wild white clover and basic slag (here meaning suitable seeds and fertilisers generally) have given some impetus to the movement. Whereas formerly it was believed that "to make a pasture will break a man" or that a profitable pasture required twenty years for development, we now have very productive grazings from the first or second year after seeding. Even the otherwise commendable practice of thoroughly cleaning the land before seeding is not now absolutely necessary; for a carpet of wild white clover has a remarkable smothering and cleaning effect, and under certain circumstances this may be much the cheapest way of cleaning land. There is now no excuse for allowing land to "tumble down to grass."

A large-scale demonstration of what wild white clover and phosphates together may accomplish may be seen on a farm in the north-east corner of Gloucestershire. When the present owner came into possession in 1922 there were on the holding in question 448 acres of almost derelict and dirty arable land, which was regarded as a very unprofitable project. Of this area, 400 acres are now beautiful and obviously profitable young pastures. When I saw them on July 13 last they were nearly all white over with the blossom of wild white clover; and, with the exception of two fields recently seeded, could be described as clean. In some cases rotation leas or beds of sainfoin existing at the date of entry had been converted into permanent grass merely by slagging and harrowing in a renovating mixture; in others, dirty stubbles had been turned over, resown with corn, and seeded down with permanent seeds; in others the seeds had been sown in rape after a half fallow. The occupier's interest lies mainly in live stock, and he intends to leave the land down in grass. It was obvious, however, that had the intention been to resume arable cultivation, the method would have been a success for that purpose, as the land is now in excellent condition for corn crops.

Live Stock.—Dairy cows do not as a rule yield well in August. Such as calve in this month produce about 10 per cent. less milk in their lactation period than similar animals that calve in October, although in some districts the difference may be less marked. This fact, however, is worthy of special consideration when assessing the merits of different cows for breeding purposes. Autumn calvers are mostly dry in August ; and the rapid decline in the yield of March calvers, which is very noticeable in this month, cannot be appreciably reduced by increasing the allowance of concentrates. Thus there is not as a rule much surplus milk in August ; and, unless there are heifers coming into the herd, the daily output may fall below contract quantity.

With the return of cooler nights and heavy dews, cattle become subject to a number of ailments about this time of the year. Dry cows have to be watched for symptoms of udder trouble, which if neglected may result in the loss of one or more quarters and sometimes in the death of the animal. Some forms of this trouble—mammitis—are undoubtedly infectious, and the fluid drawn from affected quarters must be regarded as a danger to other cows. Young cattle may begin to cough as a result of infection with the husk worm. The desirability of immediate isolation and treatment in this disease is not sufficiently understood by stock owners : the solid excrement of husking beasts contains young husk worms, which, after a period of four to twelve days, may infect another beast that picks them up off the grass.

The careful shepherd is constantly giving attention to the feet of his sheep, but he makes a special effort to get his flock sound in this respect before the more moist conditions of autumn set in. Besides, with ewes treatment is much more difficult to carry out after they become in lamb again. The term foot-rot is commonly applied to all kinds of foot affections in sheep ; more strictly it should refer only to the infectious kind of lameness, of which the first visible symptom (apart from lameness) is a sore between the toes, whereas non-infectious foot-rot commences at or near the under surface of the foot. On land that is known to be infected, it is a wise precaution to make the sheep walk periodically through an antiseptic foot bath, such as 5 per cent. copper sulphate.

MONTHLY NOTES ON FEEDING STUFFS

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Some Results of Research in America on Dairy Cows during 1924 and 1925.—In view of the extensive research on dairy science carried out in America, it may be useful to present in short and succinct form the results of such research that are of immediate interest to dairy farmers, and the following notes are a brief statement of the work of commercial instructional interest carried out in America during 1924 and 1925, and published in *Dairy Science.*

Protein for Milk Production.—In research carried out in 1924 on the protein requirements of milk production, J. A. Fries and others made the interesting observation that a reduction in the protein fed led to a reduction in the milk flow. Owing to the capacity of the cow to draw on its protein reserves for milk production, such reduction may not be manifested to its full extent until some weeks after the reduction in food protein has taken place. The effect of increasing the protein supply, however, depends upon the physiological milk yielding capacity of the cow. In the case of a good yielding cow fed on poor diet the addition of protein will lead to an immediate increase, whereas in the case of a poor yielding cow no such increase will be obtained. In all cases the authors found that storage of protein occurred in the body of the cow. These results confirm the English practice of conditioning a cow by liberal feeding during gestation in preparation for the succeeding lactation period.

Milk for Calves.—Work by McCandlish has shown that milk cannot be used indefinitely as a sole ration for calves, and that some bulky roughage such as lucerne hay is necessary for normal growth. Calves fed on milk alone eventually died.

Yeast for Calves and Cows.—Eckles Williams and others, in an attempt to ascertain the effect of yeast feeding on growth of the calf, found that the addition of yeast to rations ordinarily fed to calves did not lead to increased growth during the period the calves were under observation, *i.e.*, from three weeks to twenty-six weeks. Further work by the authors, published in 1925, showed that the feeding of yeast to lactating cows had no specific effect on milk production. In other

words, the value of yeast as a supplementary food for calves and cows depends entirely upon its protein and energy content, and bears no relation to its vitamin B content.

Age of Maximum Milk Yield.—Work by Ragsdale, Turner, and Clark show that the maximum production of milk is reached at the age of eight years in the case of the Holstein, Jersey, and Guernsey breeds, and at nine years in the case of the Ayrshire breed.

Molasses for Dairy Cows.—Paul S. Williams investigated the effect of the addition of cane molasses on the digestibility of dairy cow rations. Lindsey and Smith had previously found that addition of cane molasses depressed the digestibility of a ration, while Patterson and Outwater obtained contrary results. Williams, as the result of his experiments, obtained data which indicated no adverse effect on the digestibility of the ration, so far as fibre, carbohydrate, and fat was concerned, but did get a slight depression in the digestibility of the crude protein and the dry matter. This depression of digestibility was, however, much too slight to be of any significance in ordinary farming practice.

Soy Beans.—Fairchild and Wilber, in an experiment designed to test the value of soy beans and soy bean oil meal as a protein supplement in dairy cow ration, came to the conclusion that soy bean oil meal was as valuable as linseed oil meal as a protein supplement, and that ground soy beans had a feeding value 2 to 3 per cent. higher than linseed oil meal for milk and fat production.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows :—

	Starch equivalent	Protein equivalent	Per ton £	s
Barley (imported)	71	6·2	8	11
Maize	81	6·8	7	14
Decorticated ground nut cake	73	41·0	11	10
„ cotton cake	71	34·0	10	0

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2·10 shillings, and per unit protein equivalent, 1·97 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be

applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1925, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	8 10
Oats	60	7·6	7 1
Barley	71	6·2	8 1
Potatoes	18	0·6	1 19
Swedes	7	0·7	0 16
Mangolds .. .	7	0·4	0 15
Beans	66	20·0	8 18
Good meadow hay .. .	31	4·6	3 14
Good oat straw	17	0 9	1 17
Good clover hay .. .	32	7·0	4 1
Vetch and oat silage ..	13	1·6	1 10
Barley straw	19	0·7	2 1
Wheat straw . . .	11	0·1	1 3
Bean straw	19	1·7	2 3

DESCRIPTION	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British	—	—	14 5	0 15	13 10	72	3 9	2 01	9·6
Barley, British feeding ..	—	—	9 0	0 12	8 8	71	2 4	1·25	6·2
„ Canadian No. 4 Western	31 3	400	8 15	0 12	8 3	71	2 4	1·25	6·2
„ American	30 6	„	8 10	0 12	7 18	71	2 3	1·20	6·2
„ Russian	30 0	„	8 8	0 12	7 16	71	2 2	1·16	6·2
Oats, English, white	—	—	10 7	0 13	9 14	60	3 3	1·74	7·6
„ „ black and grey	—	—	10 0	0 13	9 7	60	3 1	1·65	7·6
„ Scotch, white	—	—	11 3	0 13	10 10	60	3 6	1·87	7·6
„ Canadian No. 2 Western	29 6	320	10 7	0 13	9 14	60	3 3	1·74	7·6
„ „ No. 3 „ ..	27 0	„	9 8	0 13	8 15	60	2 11	1·56	7·6
„ „ feed	25 6	„	8 18	0 13	8 5	60	2 9	1·47	7·6
„ American	25 6	„	8 18	0 13	8 5	60	2 9	1·47	7·6
„ Argentine	24 0	„	8 8	0 13	7 15	60	2 7	1·38	7·6
„ Chilian	24 6	„	8 12	0 13	7 19	60	2 8	1·43	7·6
Maize, Argentine	32 6	480	7 12	0 12	7 0	81	1 9	0·94	6·8
„ South African	33 6	„	7 17†	0 12	7 5	81	1 9	0·94	6·8
Beans, English winter	—	—	11 0	1 11	9 9	66	2 10	1·52	20·0
Peas, „ dun	—	—	11 10	1 7	10 3	69	2 11	1·56	18·0
„ „ maple	—	—	12 0	1 7	10 13	69	3 1	1·65	18·0
Millers' offals—									
Bran, British	—	—	5 0	1 6	3 14	42	1 9	0·94	10·0
„ broad	—	—	6 2	1 6	4 16	42	2 3	1·20	10·0
Middlings, fine, imported ..	—	—	7 5	1 1	6 4	69	1 10	0 98	12·0
„ coarse, British ..	—	—	6 0	1 1	4 19	58	1 8	0·89	11·0
Pollards, imported	—	—	5 10	1 6	4 4	60	1 5	0·76	11·0
Meal, barley	—	—	9 15	0 12	9 3	71	2 7	1·38	6·2
„ maize	—	—	8 15	0 12	8 3	81	2 0	1·07	6·8
„ „ South African ..	—	—	8 0	0 12	7 8	81	1 10	0·98	6·8
„ „ germ	—	—	7 15	0 18	6 17	85	1 7	0·85	10·0
„ „ gluten feed .	—	—	8 7	1 6	7 1	76	1 10	0·98	19·0
„ locust bean .. .	—	—	9 0	0 9	8 11	71	2 5	1·29	3·6
„ bean	—	—	12 0	1 11	10 9	66	3 2	1 70	20·0
„ fish	—	—	17 15	4 1	13 14	53	5 2	2·77	48·0
Maize, cooked flaked	—	—	10 10	0 12	9 18	85	2 4	1·25	8·6
Linseed—									
„ cake, English, 12% oil	—	—	12 2	1 16	10 6	74	2 9	1·47	25·0
„ „ „ 10% „	—	—	11 15	1 16	19 19	74	2 8	1·43	25·0
„ „ „ 9% „	—	—	11 10	1 16	9 14	74	2 7	1·38	25·0
Soya bean „ 6% „	—	—	11 10	2 11	8 19	69	2 7	1·38	36·0
Cottonseed cake, English, 5½%„	—	—	6 0	1 13	4 7	42	2 1	1·12	17·0
„ „ Egyptian, 5½% „	—	—	5 12	1 13	3 19	42	1 11	1·03	17·0
Decorticated cottonseed cake, 7% oil	—	—	10 0	2 11	7 9	71	2 1	1·12	34·0
Decorticated cottonseed meal, 7% oil	—	—	10 10	2 11	7 19	74	2 2	1·16	35·0
Coconut cake, 6% oil	—	—	8 10	1 10	7 0	79	1 9	0·94	16·0
Ground nut cake, 6% oil ..	—	—	7 10	1 15	5 15	57	2 0	1·07	27·0
Palm kernel cake, 6% oil ..	—	—	6 10	1 2	5 8	75	1 5	0·76	17·0
„ „ „ meal, 6% oil	—	—	7 0	1 2	5 18	75	1 7	0·85	17·0
„ „ „ meal, 2% „	—	—	5 10	1 3	4 7	71	1 3	0 67	17·0
Feeding treacle	—	—	6 12	0 9	6 3	51	2 5	1·29	2·7
Brewers' grains, Dried ale ..	—	—	6 7	1 3	5 4	49	2 1	1·12	13·0
„ „ „ porter ..	—	—	5 17	1 3	4 14	49	1 11	1·03	13·0
„ „ Wet ale ..	—	—	0 16	0 9	0 7	15	0 6	0·27	4·8
„ „ „ porter ..	—	—	0 11	0 9	0 2	15	0 2	0·09	4·8
Malt culms	—	—	6 2	1 13	4 9	43	2 1	1·12	16·0

† At Liverpool

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered [illegible]

[illegible] equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 3d.; P_2O_5, 3s. 3d.; K_2O, 3s. 0d.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending July 7.				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	13 10	13 0	13 0	12 17	16 7
,, lime (N. 13%) ..	..	12 10	..	12 7‡	19 0
Sulphate of ammonia—					
Neutral (N. 21·1%)	13 1*	13 1*	13 1*	13 1*	(N)12 4
Kainit (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
,, (Pot. 20%)	3 12	3 0	3 9	3 3	3 2
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate ,, (Pot. 48-51¼%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 38%)	4 0§	..	..	..	..
,, (T.P. 36%)	3 15§	..	..	..	..
,, (T.P. 34%)	..	..	3 6§	3 11§	2 1
,, (T.P. 30%)	..	2 19§	3 1§	3 6§	2 2
,, (T.P. 28%)	..	2 9§	..	..	..
,, (T.P. 26%)	..	2 4§	..	..	..
,, (T.P. 24%)	..	2 0§	2 1§	2 11§	2 1
Ground rock phosphate (T.P.58%)	2 17¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 14	3 5	1 10
,, (S.P. 33%) ..	..	..	3 11	..	..
,, (S.P. 30%) ..	3 0	2 17	3 7	2 18	1 11
Bone meal (N. 3¾%, T.P. 45%) ..	8 15	8 5	8 10	7 17	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 2†	6 10†	5 15	5 10	..
Fish guano (N. 6½%, T.P. 10%) ..	..	..	..	8 15	..

Abbreviations: N.—Nitrogen; S.P.—Soluble Phosphate; T.P.—Total Phosphate; Pot.—Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in the home counties.

§ Bristol prices are carriage paid in the counties of Wilts, Somerset, Hants and Dorset, while in Gloucester and Berks the cost to purchasers will be 5s per ton less. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton.

MISCELLANEOUS NOTES

Ormskirk Potato Trials, 1926

THE National Institute of Agricultural Botany wishes to extend an invitation to parties of farmers, potato growers, and merchants, and agricultural advisory and administrative officers, to visit the Potato Testing Station, Ormskirk, singly or in parties, on August 19 or 20, 1926, or if these dates are inconvenient, on any other week-day between August 9 and 21. Visitors will be able to see the official trials of some hundreds of new varieties of potatoes for immunity from wart disease. These trials are carried out at Ormskirk for the Ministry, which certifies the results. Other trials open to inspection include the Lord Derby Gold Medal Trials and Yield and Maturity Trials of the leading immune maincrop potatoes. There are also a large number of demonstration plots of the chief varieties of British and foreign potatoes, together with those certified by the Ministry as immune in 1924 and 1925.

Secretaries of branches of the National Farmers' Union and others wishing to organise parties to see the trials should write to the Superintendent of Potato Trials, Potato Testing Station, Lathom, Ormskirk, Lancs., suggesting alternative dates. Individual visitors will be equally welcome, but they, too, should inform the Superintendent of the date of their visit not less than a week in advance. Ormskirk is conveniently reached by a frequent service of local trains from either Liverpool or Preston, and lunch may be obtained in the town.

* * * * * *

Hop-pickers' Accommodation

FOLLOWING consultations with the Ministry of Agriculture, the National Farmers' Union, local authorities, and other interests concerned, the Ministry of Health has prepared a revised model series of bye-laws regulating the accommodation of persons engaged in the picking of hops, fruit, and vegetables. Copies of these bye-laws have been sent to the local authorities in the counties of Kent, Hereford, Sussex, and Worcester, with a request that the Councils concerned should, without delay, consider the question of adopting them in time to come into force by the commencement of this year's operations. For the present it is not proposed to take similar steps in other counties. The Ministry hopes that all farmers and other persons concerned in the

cultivation of hops will give their support to the efforts which are being made to improve the housing conditions of the pickers. It is felt that the revised model bye-laws, while constituting a step in the right direction, should not prove unduly onerous to the industry.

The following is a copy of the Model Bye-laws as drawn up by the Ministry of Health :—

Every person who for persons engaged in hop-picking or in the picking of fruit and vegetables provides any lodging not ordinarily occupied for human habitation, shall comply with the following rules :—

(i) He shall, before erecting a new lodging, give to the Council in writing at least *twenty-eight days'* notice of his intention so to erect it.

(ii) He shall, before a lodging is used in any year after the year in which it was erected, give to the Council at least *three days'* notice of his intention so to use it.

(iii) He shall cause the lodging to be so constructed and maintained that it may be clean, dry, and weatherproof at all times when so used.

(iv) He shall not cause the lodging to be used unless its site is reasonably free from damp at such times as it is to be so used.

(v) When a new lodging is erected he shall provide in front of it (or, where lodgings are constructed as a block, in front of each such block) an open space free from any erection and exclusively belonging to or used with the lodging or block which shall extend

(*a*) to a distance of *fifteen feet* if lodgings or blocks are not erected face to face,

(*b*) to a distance of *twenty feet* between lodgings or blocks erected face to face.

(vi) When a new lodging is erected he shall so place it that there is not behind it any obstruction so near as to interfere with the access of air and light.

(vii) He shall cause the lodging to be provided with proper and sufficient means of ventilation and lighting by natural light.

*(viii) He shall not cause to be received into the lodging or into any room therein at any one time for sleeping a greater number of persons than will allow *eighteen square feet* at the least of available floor space, in respect of each person employed or forming one of the family of a person employed by him.

For the purpose of this rule two children under *twelve years* of age shall be counted as one person.

(ix) He shall

(*a*) cause every room or part of the lodging, which may be intended to be used for sleeping by adult persons of different sexes, to be divided into compartments in such a manner that every compartment shall be properly separated from every other compartment by a suitable screen or partition of such material, construction, and size as to secure adequate privacy to the occupant or occupants of the compartment when so used ;

* *It is suggested that in connection with this bye-law Local Authorities should print placards with spaces left blank for the figures. These placards could be given to the farmers with a suggestion that, in order to prevent contraventions of the bye-laws, and in their own interest, they should be put up in the huts.*

(*b*) not cause any compartment to be appropriated for the use of adult persons of different sexes

Provided that this rule shall not be deemed to prohibit the appropriation of a compartment for the exclusive use of a single family comprising the following persons or any of them, that is to say, a husband and his wife and their children not exceeding the age of *fourteen years*

For the purpose of this rule "adult person" means a person exceeding the age of *twelve years*

(x) He shall provide, in a safe and suitable position in, or in connection with, or adjacent to each lodging or block of lodgings, a suitable cooking house, or other place, properly covered or sheltered, in which fires may be safely and readily lighted, and food may be properly cooked, and clothes and other articles may be properly dried

He shall cause the cooking house or place to be so constructed that for every *fifteen persons* allowed by rule (viii) of this bye law to be received in the lodging or block of lodgings a separate fireplace or separate accommodation for the cooking of food and the drying of clothes and other articles may be provided

(xi) He shall (where it is not otherwise readily available) provide in or upon or in connection with the lodging, or in some suitable place readily accessible therefrom, such a supply of good and wholesome water as will, at all times, suffice for the reasonable requirements, whether for drinking, cooking, or washing of the several persons received into the lodging

(xii) He shall provide for every person received into the lodging a sufficient supply of clean, dry straw, or other clean, dry, and suitable bedding, which if it be straw or other similar bedding shall not have been previously used, and shall renew it from time to time as may be reasonably necessary

(xiii) He shall cause every part of the interior of the lodging, and of any cooking house, privy, or other premises in connection therewith, to be thoroughly cleansed immediately before any person shall be received in the lodging

He shall cause the walls and ceilings of every room constructed of brick, stone, iron, concrete, wood, earth, or plaster to be well and sufficiently lime washed or treated with some other form of disinfectant *once in every year not more than two months before occupation*

(xiv) He shall cause all accumulations or deposits of refuse, filth or any offensive or noxious matter to be removed daily from the lodging and from the land immediately surrounding or adjoining it

(xv) He shall provide, in a suitable position in connection with every lodging or with every group of lodgings, water closets, earth-closets or privies properly constructed (and, in the case of earth closets and privies, of sufficient depth) for the separate use of each sex, and a not less number than one for every twenty persons (including children) lodged The water-closets, earth-closets, or privies shall be marked MEN and WOMEN AND CHILDREN respectively, and those marked MEN shall be at a reasonable distance from those marked WOMEN AND CHILDREN.

He shall cause the contents of earth-closets or privies to be covered once each day with dry earth or other suitable absorbent material and removed when necessary. He shall cause the contents of movable receptacles used for such purposes to be removed daily.

Agricultural Scholarships for the Colonies

THE Ministry is informed that the Colonial Office intend to award sixteen to eighteen post-graduate scholarships in agriculture and agricultural science annually for a number of years, provided that a sufficient number of suitable candidates present themselves. The object of the scholarships is to create a pool of properly qualified men from which vacancies in the Colonial Agricultural Departments can be filled. If applying for a science research or specialist scholarship, candidates should hold an honours degree in pure science of a standard not lower than Part II of the Cambridge Natural Sciences Tripos. If they apply for a general agricultural scholarship, however, candidates should be possessed of a degree or diploma in agriculture or natural sciences (of which botany must be one) which has entailed not less than a three-years' course of study at a university or an agricultural college. Candidates may apply before taking their final examinations.

A scholarship will usually be tenable for two years, the first being spent in this country and the second at the Imperial College of Tropical Agriculture, Trinidad, or at some similar institution abroad; but scholarships for one year only may be granted at the discretion of the Secretary of State.

The money value of each scholarship is £250 per annum, from which the fees of training institutions must be paid. Passage expenses overseas are, however, provided in addition, and also the cost of any travelling, if required, whilst abroad. The scholarships do not carry with them any guarantee of subsequent appointment to colonial services, but it is expected that most of the scholars will be offered such appointments on the conclusion of their training, provided that their work and conduct have been satisfactory.

Fuller particulars can be obtained from the Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W. 1. The selection is made annually in the summer and the lists for this year are closed.

* * * * * *

Foot-and-Mouth Disease and Packing Materials

A TIMELY warning to farmers and others is provided by the case of a pig-keeper who was recently prosecuted and fined £15 and 10s. costs for failing to observe the conditions of the Foot-and-Mouth Disease (Packing Materials) Order, 1925. This Order requires that no hay or straw used for packing materials, whether for imported goods or not, shall be brought into

contact with any animal in Great Britain. Nor may hay or straw packing be removed from any premises unless used again as packing, or it is taken away to be destroyed or to be returned to the sender. Trees, shrubs, plants, or other horticultural products packed in hay or straw may not be exposed for sale or stored on premises at the same time as animals are being sold there. In addition, any material used as a wrapping for carcasses or meat products may not be brought into contact with any animal in Great Britain until it has been thoroughly sterilised by boiling, or by some other effective method. Boxes, crates, baskets, and other receptacles which have been used for the carriage of meat offals, carcasses, or meat products are not allowed to be brought into contact with any animal in this country.

In the case of the pig-keeper mentioned, he had allowed the wrappings from imported meat to come into contact with his own stock.

* * * * * *

The Snell Memorial Medal, 1925

THE Council of the National Institute of Agricultural Botany have awarded the Snell Memorial Medal for the year 1925 to Redcliffe N. Salaman, J.P., M.D., M.A., for the last seven years Chairman of the Potato Synonym Committee. The medal is given annually to mark distinguished work in the sphere of potato husbandry, and it has been awarded to Dr. Salaman in recognition of his services in the study of the problems connected with the breeding and the diseases of potatoes. His principal work has been in the direction of the genetical analysis of the characters of the potato, and he has paid particular attention to studies of yield and of resistance to virus diseases. The medal will be presented to Dr. Salaman at the public inspection of the trials at the Potato Testing Station, Ormskirk, on August 19.

* * * * * *

The Agricultural Index Number

THERE was a further fall during June in the general level of the prices of agricultural produce, the index number being 48 per cent. above 1911-13 against 50 per cent. in May. The figure for June is lower than in any previous month since the war, but on three occasions in the last three years the index number has been only 1 point higher than that of last month.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921 :—

Month	Percentage Increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	180	71	67	60	71	58
February	164	75	63	61	69	53
March ..	146	73	59	57	66	49
April ..	145	66	54	53	59	52
May ..	115	69	54	57	57	50
June ..	105	64	49	56	53	48
July ..	103	67	50	53	49	—
August	122	68	52	57	54	—
September	113	59	52	61	55	—
October	82	61	50	66	53	—
November	74	63	51	66	54	—
December	71	61	55	65	54	—

Live Stock.—Fat cattle became rather cheaper during June and were only 40 per cent. above the pre-war price, as compared with 50 per cent. in June, 1925. Prices of fat sheep also declined, but as a reduction usually takes place in June the index number was practically unchanged at 66 per cent. above 1911-13. The index figures for fat pigs were also practically unaltered, although the average prices declined by 3d. and 4d. per stone for porkers and baconers respectively. Fat sheep continue much cheaper and fat pigs dearer than a year ago. Pigs are relatively dearer at present than any other class of agricultural produce. The trade for dairy cattle has been rather better for a few weeks and the decline in prices has been checked, but, at only 38 per cent. above pre-war, cows are comparatively cheap. Store cattle are even cheaper, the average price during June being only 28 per cent. above 1911-13, which compares with 43 per cent. in June, 1925. The demand for store sheep improved during June and the prices realised were 71 per cent. above pre-war, whilst the trade for store pigs has been very keen and prices advanced to an even higher level than previously, the index number being 134 per cent. above 1911-13. The demand for pigs has been strengthened by the embargo on imports of fresh meat from the Continent.

Grain.—There has been little British wheat on the market during June and prices have tended to harden, so that the index number advanced by 4 points to 71 per cent. above the basic price. Barley has become cheaper, the average price during June being 9s. per cwt., but oats have been very steady

at slightly under 10s. per cwt., the index numbers being only 21 per cent. and 31 per cent. respectively above 1911-13. Barley and oats were cheaper than a year earlier, but wheat made better prices than in June, 1925.

Dairy and Poultry Produce.—There was no change in the contract prices for milk during June. Butter declined by ½d. per lb., but, as the fall was relatively rather less than in the basic years, the index number advanced by 2 points to 54 per cent. above 1911-13. Cheese also became cheaper, but Cheddar cheese sold wholesale at 80 per cent. above the pre-war price. Prices of butter and cheese were very similar to a year earlier, the former being slightly cheaper and the latter a trifle dearer. Eggs did not show the usual seasonal advance in June, in fact they averaged ¼d. per dozen less than in April or May, and, as a result, the index number declined by 12 points to only 26 per cent. above the basic price. Last year there was an advance of 1½d. per dozen in June, and, as compared with June last year, prices were about 2¾d. per dozen lower.

Other Commodities.—Prices of old potatoes declined at the end of May, and during June they were slightly below the pre-war price, and about 50 per cent. cheaper than a year earlier. Cabbage and cauliflowers, though rather cheaper than in May, were comparatively dear, as compared with pre-war, the former selling at double and the latter at more than double the pre-war price. Hay prices were slightly lower on the month, but the index figure was unchanged at 9 per cent. above 1911-13.

Index numbers of different commodities during recent months and in June, 1924 and 1925, are shown on the opposite page.

The general index numbers of the prices of agricultural produce given in the first table in this article differ slightly from those appearing in previous issues of this *Journal*. A difficulty in connection with the monthly index numbers arises in the case of a few commodities which are not sold at all seasons of the year, such as fruit, vegetables, wool and hops. Hitherto fruit and vegetables have been taken into account in calculating the monthly index numbers in those months only when they were on sale, but no account has been taken of wool and hops. The inclusion of fruit and vegetables in some months has had a tendency to disturb comparison between one month and another, and it has been decided to omit these in calculating the monthly general index numbers. Wool prices, however, will be included,

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	June	June	Mar.	April	May	June
Wheat	42	62	55	57	67	71
Barley	48	38	14	18	22	21
Oats	32	38	25	26	30	31
Fat cattle	55	50	43	39	43	40
Fat sheep	93	93	52	59	67	66
Bacon pigs	29	54	85	82	88	87
Pork pigs	33	53	89	84	90	90
Dairy cows .. .	59	47	37	39	36	38
Store cattle	47	43	31	31	29	28
Store sheep	121	115	61	60	55	71
Store pigs	32	55	115	119	122	134
Eggs	43	52	41	48	38	26
Poultry	93	61	50	46	61	70
Milk	50	55	72	95	60	60
Butter	43	57	46	49	52	54
Cheese	83	78	77	77	83	80
Potatoes	174	76	31	7	15	−5*
Hay	3	3	6	5	9	9

* Decrease.

nominal prices based on the movements in wool prices at Bradford being used in those months when wool sales are not taking place throughout the country. The index numbers for each month back to January, 1921, have been recalculated on this basis and are given above. A fuller explanation of these changes will be found in Part III of the Agricultural Statistics for 1925 which will be published in a few days.

Minimum Wages for Harvest Work.—Eleven of the Agricultural Wages Committees have fixed special minimum rates of wages for employment on this year's corn harvest, and one other Committee has given notice of a proposal to fix such rates. Brief particulars of the rates for adult workers are given below, and copies of the Orders of the Agricultural Wages Board containing full details, including the rates for younger workers, can be obtained from the Ministry. The other thirty-five Agricultural Wages Committees have not fixed special rates for the purpose, and consequently, so far as the Agricultural Wages (Regulation) Act is concerned, employment on the corn harvest in those areas will be payable simply at not less than the ordinary minimum and overtime rates.

ORDERS MADE

Cambridgeshire and Isle of Ely.—Male workers, twenty-one years and over, minimum rate of 60s. for sixty-four hours per week (excluding Sunday) with overtime at 11½d. per hour for all employment on Sunday and in excess of sixty-four hours per week. Female workers, eighteen years and over, 8d. per hour for all employment on harvest work.

Derbyshire.—Male workers, twenty-one and over, special overtime rate of 9d. per hour.

Devon.—Male workers, twenty-one years and over, special overtime rate of 10d. per hour.

Dorset.—Male workers, twenty-one years and over, special overtime rate of 10d. per hour.

Essex.—Male workers, twenty-one years and over, employed on farms comprising more than sixty acres of corn and who work the full harvest period, a bonus of not less than £5 5s. 0d. shall be payable to cover all overtime employment Male workers of twenty-one years and over employed on farms comprising sixty acres of corn or less, 10½d. per hour for all employment on harvest work Female workers, twenty-one years and over, 7½d per hour for all employment on harvest work

Hampshire and Isle of Wight—Male workers, twenty one years and over, special overtime rate of 9d per hour

Hertfordshire.—Special minimum rates of 10½d per hour for male workers of twenty-one years and over, and of 7½d per hour for female workers of twenty-one years and over, for all employment on harvest work.

Norfolk.—Male Workers, twenty one years and over, who work the full twenty-four days or the full harvest period, an inclusive sum of £11 to cover all time spent on the harvest For male workers who do not work the full period the ordinary minimum rate of 30s. for a week of fifty hours with overtime payment at 9½d. per hour.

Somerset—Male workers, twenty-one years and over, special overtime rate of 10d. per hour.

Wiltshire.—Male workers, twenty-one years and over, special overtime rate of 9d. per hour

Yorkshire, East Riding.—Special overtime rates. Male workers, twenty-one years and over, not boarded and lodged by their employer, 1s. 3d. per hour ; special classes boarded and lodged by their employer, 1s. per hour ; female workers, sixteen years and over, 11d per hour.

NOTICE OF PROPOSAL

The Suffolk Agricultural Wages Committee have given notice of a proposal to fix special overtime rates for male workers employed on the corn harvest, the rate for workers of twenty one years and over being 1s. 4d per hour. The proposal contains a provision guaranteeing to regular workers payment for seventy-five hours at the special rates.

An Order putting the proposed rates into operation cannot be made until after July 31 when the period allowed for objections expires.

Farm Workers' Minimum Wages.—A Meeting of the Agricultural Wages Board was held on July 13 at 7 Whitehall Place, S.W 1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions.

Lancashire.—An Order to come into operation on July 19 varying the overtime rates of wages for male workers, the rate in the case of workers aged twenty-one years and over being reduced from 1s. to 11d. per hour.

Cambridgeshire and Isle of Ely.—An Order to come into operation on July 19, fixing special minimum rates of wages for employment on this year's corn harvest, the rate in the case of male workers,

aged twenty-one years and over, being 60s. per week of sixty-four hours (excluding Sunday), and in that of female workers of eighteen years of age and over 8d. per hour.

Essex.—An Order to come into operation on July 19 fixing special minimum rates of wages for employment on this year's corn harvest. The Order provides that all male workers employed throughout the harvest on farms comprising over sixty acres of corn shall be paid the ordinary minimum weekly rates, plus a bonus on the completion of harvest in the case of workers aged twenty-one years and over of £5 5s. In the case of male workers on such farms not employed fully on the harvest only a proportionate part of the bonus is payable. On farms comprising sixty acres or less of corn, male workers are to be paid at special hourly rates for all employment on the harvest, the rate in the case of workers aged twenty-one years and over being 10½d. per hour. In the case of female workers all employment on the corn harvest is to be paid for at special hourly rates, the rate for workers aged twenty-one years and over being 7½d. per hour.

Wiltshire.—An Order to come into operation on July 19 fixing special rates of wages for male workers for overtime employment on the corn harvest, the rate in the case of workers aged twenty-one years and over being 9d. per hour.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

Enforcement of the Minimum Rates of Wages.—During the month ending July 15 legal proceedings were instituted against six employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers employed in agriculture. Particulars of the cases are as follows :—

County	Court	Fines			Costs			Arrears ordered to be paid			No. of workers concerned
		£	s.	d.	£	s.	d.	£	s.	d.	
Northants ..	Kettering ..	2	0	0		—		8	19	9	1
Kent ..	Seabrook ..	1	0	0		—		13	16	4	1
Somerset ..	Shepton Mallet	1	0	0	0	10	0	9	1	4	1
Wilts ..	Chippenham ..	2	0	0		—		5	0	0	1
Isle of Wight	Newport ..		--		5	5	0	23	3	0	1
Somerset ..	Glastonbury	*	—			—		*	—		6

* Conviction recorded, arrears to be agreed.

Two employers were also proceeded against at Haverhill (Suffolk) and Tonbridge (Kent) under Section 9 (3b) of the Agricultural Wages (Regulation) Act, 1924, for refusing to give information lawfully required by the Inspectors concerned. In the first case the employer was fined £5 and £2 2s. 0d. costs, and in the second case a fine of £20 was inflicted.

Export of Plants to Denmark.—Regulations have recently been made by the Danish Government under which plants imported into Denmark must be accompanied by a certificate from the Plant Inspection Service of the country of origin, stating that they were grown in a locality free from infection with Wart Disease of Potatoes and situated at least

ten kilometres from any place where Wart Disease has occurred during the past ten years.

The Danish Government has, however, agreed to grant individual exemptions from the regulations in cases where the above-mentioned certificate cannot be issued, on condition that each consignment of plants is accompanied by a certificate from the Ministry of Agriculture and Fisheries indicating the distance between the place where the plants were grown and the nearest case of Wart Disease. Precise information as to the quantity and quality of the plants to be sent from the place in question must be given.

Nurserymen and others who desire to send plants to Denmark should first ascertain from the Ministry which form of certificate can be issued, as the importer will be obliged to submit to the Ministry of Agriculture at Copenhagen a request for the admission of plants grown within ten kilometres from an outbreak of Wart Disease.

" Trials of Tar-Distillate Washes."—In the article upon this subject, published in last month's (July) issue of this JOURNAL, the name of "Mortegg" was inadvertently omitted from the list of proprietary washes mentioned, in paragraph 1 on page 336, as having given, at 6 per cent. concentration, satisfactory control of aphis on plums. The "Egg-killing Winter Wash," advertised by Messrs. George Monro, Ltd., in the same issue, was not one of the proprietary washes employed in the trials to which this article referred.

Foot-and-Mouth Disease.—Twenty further outbreaks of foot-and-mouth disease have occurred since the issue of the July number of this JOURNAL, eleven of which have occurred in the Lanarkshire area previously referred to. New centres of disease have also been established, by confirmation of the disease at Coppenhall, Crewe, Cheshire, on June 22; at Elmstead, Colchester, on June 25; and at Kinver, Staffs. on July 7. In the case of the last two mentioned outbreaks, no developments have taken place; but in the Cheshire area, six other outbreaks have been confirmed since the original case. In all, there have been 111 outbreaks from January 1, 1926, involving 20 counties.

NOTICES OF BOOKS

The British Goat Society's Year Book for 1926. (Compiled and issued by the Honorary Secretary, Thomas W. Palmer, 10 Lloyd's Avenue, E.C. 3. 164 pp. Price 1s. 6d.)

The sixth issue of this annual shows improvement even over the high standard set by its editor in previous years, and should be obtained by all goat keepers. In addition to information regarding the various activities of the Society, there are over 50 remarkably good illustrations, among which may be mentioned a photograph of Didgemere Dream, whose recorded milk yield with its first kid, during 130 days ending October 1, 1925, totalled 2,008 lb. 9 oz. It may be mentioned that at the Chester Royal Show last year this animal yielded 17 lb. 8 oz. of milk in one day, *i.e.* about 7 quarts, with butter-fat content of 3.91 to 4 per cent.—a remarkable proof of the milk-producing capabilities of the goat. Space precludes mention of more than a few of the interesting and informative articles contained in this Year Book. Dr. G. H. T. Stovin contributes a chapter on "Goats' Milk and its Value as a Food" for infants and invalids: Dr. R. Stenhouse Williams emphasises the importance of hygiene in "The Handling of Goats' Milk"; while

significant analyses are given in "Milking and the Composition of Milk," by S. J. Watson, M.Sc. A review of recent "Research in Goat Breeding," by A. D. Buchanan Smith, describes briefly results achieved by the Animal Breeding Research Department in Edinburgh in some investigations which will, it is hoped, eventually prove of great practical value to goat breeders. Dr. S. A. Asdell writes on "The Breeding Season," and Mr. J. A. Caseby explains a method of artificial "Kid Rearing" by means of a mechanical "foster mother." Goat keepers have their own goat house problem, concerning which Miss C. Scaramanga supplies some suggestions. An interesting account of "Goats in Egypt" from the pen of a former veterinary inspector to the Egyptian Ministry of Agriculture, and descriptions of the goat industry in Australia, Canada, and other parts of the Empire, are also included in the volume, which will repay study by those who are interested in the care and management of goats.

Norwegian Agriculture. By O. T. Bjanes, Director-General of Agriculture. (Oslo. J. W. Cappelens.)

Norway has an area of just under 125,000 square miles, most of which, as Kipling remarked in another connection, "stand on end by reason of the nature of the country." This characteristic, and a position astride the Arctic Circle, largely determine the scope and character of Norway's agriculture. Of the total area, some 70 per cent. is mountainous and unproductive, 22 per cent. forest, and only about 3½ per cent. (approximately 1,675,500 acres) is under cultivation. Of this cultivated land, 639,000 acres are arable, the remainder being "artificial meadow," presumably temporary and permanent pasture, as an additional 681,000 acres are classified as "natural meadow." About a quarter of the forest area, too, is interspersed with rough pasture which, although often far away from farms, is used for summer grazing.

The predominance of pasture naturally indicates stock raising as the chief activity of the Norwegian farmer, the fodder crops and the bulk of the cereals raised being used for feeding livestock which, in most parts of the country must be stall-fed from September or October to June. A considerable portion of Mr. Bjanes' book is, consequently, devoted to descriptions of the hardy native breeds of horses, cattle, sheep, pigs, and goats, with details of the State schemes for improving the breeding of horses and cattle. The last-named are kept mainly for dairying purposes, and present efforts, generally speaking, are being directed towards reducing the number of different breeds.

Another section of the work is devoted to the system of agricultural education and a third to Forestry. About 880,000 people, or something over 33 per cent. of the total population, are connected with agriculture and forestry; and the Norwegian farmers, with few exceptions, are the owners of their land. Less than half the 248,000 separately registered holdings, however, can properly be called farms, the average area of cultivated land on all holdings being only about 7 acres. Over 92 per cent. of these holdings have less than 25 acres of cultivated land and only 26 farms in the whole country have more than 247 acres of arable and "artificial meadow" land. Most farmers, however, possess more or less large stretches of forest, grassland or mountain pasture which contribute considerably to the yield of the farm and often provide the main part of the farmer's income. Naturally, the latitude confines farm work to a short season, which extends from April or May until the end of October; work is done at high pressure, with no thought of an 8-hour day for either the farmer or his people, and very extensive use is made of labour-saving implements and machinery.

In horticulture, Norway is largely self-supporting both in the matter of fruit and vegetables, and "for the benefit of foreigners seeking

information on the subject," Mr. Bjanes has given, with the authority of his official position, a clear and cogent survey of Norway's agricultural industry, pursued under difficult conditions and in the face of adverse climatic influences. The book, which is printed in English, is well and liberally illustrated.

The Principles and Practice of Horticulture. By A. S. Galt. (Cambridge University Tutorial Press. Price 3s. 6d. net.)

In attempting to set out the principles and practice of horticulture in a little book of 240 pages, the author has set himself a big task. Horticulture began almost at the beginning of time, and has been practised through the ages, but only recently have the principles attracted the attention of scientific researchers. The old-time practices are now undergoing critical examination at the research institutions throughout the world, and the writer in his little book briefly touches on the results of a number of such inquiries. Horticulture is concerned with the production of certain classes of plants, and the writer was wise in including chapters on soil, its make up, lime requirements, water holding capacity, and methods of drainage. The measure of the fertility of a soil is defined as its power to carry crops, and it is explained that fertility is satisfactory only when the three groups of factors—the chemical, physical, and biological—are brought nicely to balance. This little chapter on the meaning of soil fertility is well presented and paves the way for a readier appreciation of those that follow, on the principles of manuring and cultivation, in which sound advice is given.

Rotation in cropping has never weighed heavily with the majority of amateur gardeners, yet we must agree that the code of rules laid down by the writer for the rotation of dissimilar crops, should be observed.

The information on the practical growing of both vegetables and fruit is very general. It is sufficient to catch the interest of the horticultural student, but the instructions as to the selection of varieties, their cultivation and time of sowing, are far too vague to permit of use for gardening work. This lack of detail in practical work is perhaps its chief defect.

Fruit growing occupies but a small place in the book, and the information given is of a general kind. The writer sees a use for the dwarfing apple stocks in that they will produce a small tree without much restrictive root and top pruning. Apparently the author's ideas of pruning, as the result of recent research work, are undergoing a change, for first, he outlines the old ideas as to the objects of pruning, *i.e.*, (1) to make and shape the tree, (2) to keep it within certain prescribed limits, (3) to conserve, control, and direct its energies, and (4) to promote fruitfulness ; and then he proceeds to show that the making of wounds must have a weakening effect on the tree, from which it follows that the fewer and smaller the wounds the less the tax upon the tree as the re ult of the healing-up process. It is argued that young apples may with safety be hard pruned, whereas old apple trees would, and do, resent it. At the best the author regards pruning as a necessary evil.

The little book has evidently been written as a manual for students attending horticultural courses, for which purpose it is well suited ; but in no sense can it be used as a gardening guide by amateurs, or as a reference book for practical work. H.V.T.

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NOTES FOR THE MONTH

Alcohol from Sugar Beet

THE Minister of Agriculture and Fisheries appointed in January last a committee, consisting of Sir Robert Robertson (Chairman), Sir Joseph Petanel and Mr. W. A. S. Calder, to consider ten technical questions involved in the manufacture of alcohol from sugar beet for power purposes, and to report upon:—

(*a*) the probable cost of production of alcohol from sugar beet at a given price per ton;

(*b*) the value of alcohol for power purposes as compared with petrol and benzol and the comparative price at which it could be sold in competition with these fuels;

(*c*) the quantity of alcohol that should be regarded as equivalent to 1 cwt. of sugar, should the Government decide to accord some assistance to the industry;

(*d*) the prospects of alcohol production by synthetic processes.

The Committee's report* has now been published, and the following is a summary of its findings:—

(*a*)- (1) *The cost of raw material*, referred to a gallon of alcohol, after allowing for the value of residual products, should be be taken as 5 per cent. of the price per ton of beet.

(2) *Manufacturing cost, i.e.*, the total cost of conversion should be put at the rate of 9d. per gallon.

Thus, with sugar beet at £1 and £2 per ton respectively, the cost per gallon of 95 per cent. alcohol net naked at works would be 1s. 9d. and 2s. 9d. respectively.

(3) In addition, there are costs due to denaturation, packages, transport and selling charges.

(*b*) For use in internal combustion engines of present design, one gallon of 95 per cent. alcohol is equivalent to less than three-quarters of a gallon of petrol. It is possible that if the situation is skilfully handled from the commercial point of view, a market for a moderate quantity of fuel alcohol at approximately the same price as petrol might be secured.

(*c*) The theoretical yield of 95 per cent. alcohol from 1 cwt. of sucrose is eight gallons. Of this 85 per cent. can be obtained in good practice, so that the practical yield would be 6·8 gallons of 95 per cent. alcohol from 1 cwt. of sucrose.

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* To be obtained from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, price 6d. net.

(*d*) The present position with regard to the production of alcohol by synthetic processes is obscure, but the effect of the development of such processes would undoubtedly be to exercise a restraining control on the price of petrol and other materials. It should be borne in mind that the production of other fuels, by synthetic or other means, suitable for use in internal combustion engines, will have a similar effect in controlling prices.

Neither for the production of synthetic alcohol nor for substitute hydrocarbon fuels can it be expected that a reliable statement as to costs will be available for a few years.

A Successful Small Holdings Association

IT is pleasing to be able to record the success of the Bournemouth and District Ex-Service Men's Small Holdings Association, Ltd. After the War there was an insistent demand by Bournemouth ex-Service men for "a piece of the land for which they had fought"; and the men formed themselves into a registered association in order to secure small holdings. The Bournemouth Town Council having declined to take any action, the Hampshire County Council, with commendable public spirit, agreed to take over the responsibility for dealing with the Bournemouth applicants, and in order to satisfy the association's requirements the Council acquired three properties situated some three to five miles from Bournemouth. A total area of about 600 acres was let to the association, who have sub-let it to their members. The tenants are mainly engaged in market gardening and fruit growing, strawberries being an important crop. About 400 acres are cultivated on the intensive system.

Seventeen men were employed on these Bournemouth estates when they were let as large farms; but to-day no fewer than 122 men, small holders and their labourers, are deriving a living from the land. This large growth in population, coupled with the fact that the major portion of the land is intensively cultivated, will afford some indication of the great increase in productivity that must have resulted from the development of these properties as small holdings. Moreover, although most of the land is devoted to market gardening, it should be mentioned that to-day the small holders have over 500 pigs, whereas none were kept when the land was occupied as large farms. In addition, there are 125 cows, as compared with 164 originally kept, and over 2,000 head of poultry.

In the early years of their tenancy the small holders experienced bad seasons and were hard hit by the low prices obtainable for their produce, with the result that in 1923

their position was somewhat precarious. In that year a number of the tenants decided to embark on fruit-growing, and at the association's request the Ministry advised them on the proposed venture.

It must be a source of satisfaction to the Hampshire County Council, as it is to the Ministry, that the improvement shown in the cultivation of these holdings during the past two or three years has been truly remarkable. The progress of this association affords striking evidence that the success of a colony of market gardeners depends very largely upon capable management at the head of affairs, and in this respect the association may consider themselves particularly fortunate.

Young Farmers' Clubs : Cattle-Judging Contest

THROUGH the courtesy of the Council of the Sussex Agricultural Society, the contest in dairy cattle-judging between teams representing the Young Farmers' Clubs of the United States and of England took place at the Sussex Show at Eastbourne on July 14, a gold challenge cup and medals being presented by the directors of the *Daily Mail.*

America was represented by three boys :—

Arthur Dunnigan, Hartford County, Maryland,
Stanley Sutton, Kent County, Maryland,
Ralph Walker, Montgomery County, Maryland,

in charge of Dr. F. B. Bomberger, B.S., M.A. (Assistant Director of Extension Service, Maryland University, and Chief of the State Department of Markets), and Mr. H. B. Derrick, B.S. (County Agricultural Agent, Kent County, Maryland), who was responsible for the training of the team.

England was represented by a girl and two boys from Sussex :—

Edith Harriott, Heathfield Calf Club,
John Harper, Sussex Baby Beef Club, Hayward's Heath,
Edward Wise, Sussex Baby Beef Club, Hayward's Heath.

The English team had been trained by Messrs. Noakes and Paget (leaders respectively of the Hayward's Heath and Heathfield Clubs), in co-operation with Mr. R. H. B. Jesse (Director of Agriculture for East Sussex).

The judges were Professor Kildee, of the University of Iowa, U.S.A., and Captain Allan Skelton. Mr. E. A. Weir, Canada,

officiated as umpire. Mr. M. D. Bannister, of Hayward's Heath, acted as timekeeper. Great interest was taken in the contest, and there was a large gathering round the ring while the judging proceeded.

The conditions were that each competitor should judge three rings of dairy cattle, Jersey, Shorthorn and Friesian. There were three cattle in each ring. Twelve minutes were allowed for placing the animals and two minutes for stating the reasons for such placing to the judges. A shorthand writer took verbatim notes of each competitor's reasons, and these are now available as a useful and instructive guide for future reference to trainers and competitors in connection with similar judging contests. The standard maintained throughout the contest was very high, and reflected credit on the training of the teams, as the following points, obtained out of a possible total of 300, clearly indicate :—

Edith Harriott	(England)	283
Edward Wise	(England)	280
Ralph Walker	(America)	279
Arthur Dunnigan	(America)	269
John Harper	(England)	265
Stanley Sutton	(America)	263

The English team, therefore, scored 828 points against 811 scored by the American team, and gained a highly creditable victory, winning the gold cup for the first time. It is noteworthy that Edith Harriott gained first place against all the male members of the teams.

The presentation of the trophy and medals took place in the principal ring during an interval in the jumping competition, and was made by the President, the Marquess of Hartington, M.P. In handing the cup to Mr. R. G. Noakes, the leader of the Hayward's Heath Club, his Lordship warmly congratulated the team upon their success and expressed his pleasure that a Sussex team had won the honour for England. Silver medals were handed to members of the winning team and bronze medals to the American boys, who especially complimented Edith Harriott on her splendid success in this competition.

* * * * * *

THE following explanatory Memorandum was issued by the Ministry on August 6 :—

Tithe Act, 1925

The appointed days for the purpose of the Tithe Act, 1925, have now been fixed by Order in Council dated July 26, 1926.

As a result, the provisions dealing with the stabilisation of the value of annual tithe rentcharge at £105 for every £100 par or commuted value, and the transfer of ecclesiastical tithe rentcharge to Queen Anne's Bounty, will operate as from March 31, 1927. This will mean that the half-yearly instalment of tithe rentcharge, both ecclesiastical and lay, which falls due for payment on April 1, 1927, will be computed on the above basis. In addition a sinking fund payment for the purpose of redemption, at the rate of £4 10s. per annum in respect of every £100 tithe rentcharge, par or commuted value, permanently attached to a benefice or to an ecclesiastical corporation immediately before March 31, 1927, will also be payable as from April 1, 1927.

As regards the rating of ecclesiastical tithe rentcharge, the appointed day for the purpose of Section 7 of the Act of 1925, has been fixed as October 1, 1926. Under that Section, the Commissioners of Inland Revenue will pay the whole of the rates assessed on or after that date in respect of such tithe rentcharge vested in Queen Anne's Bounty, recovering from the Bounty as regards each £100 tithe rentcharge, £5 in respect of tithe rentcharge attached to a benefice, and £16 in respect of tithe rentcharge attached to an eccelsiastical corporation. The rates made in October, 1926, will be in respect of the tithe rent charge accruing during the half-yearly period October 1, 1926 to March 31, 1927, and due on April 1, 1927. As a necessary corollary the Ecclesiastical Tithe Rentcharge (Rates) Acts, 1920 and 1922, giving temporary relief from rates to the owners of ecclesiastical tithe rentcharge, will cease to have effect as from October 1, 1926, which has consequently been fixed as the appointed day for the purpose of Section 25 of the Tithe Act, 1925.

The expression "ecclesiastical tithe rentcharge," in this memorandum, means tithe rentcharge which immediately before March 31, 1927, is attached to a benefice or to an ecclesiastical corporation.

Section 2 of the Tithe Act, 1925, dealing with the synchronisation of dates of payment of tithe rentcharge, and Section 17 dealing with the redemption of lay tithe rentcharge, came into operation on the passing of the Act, namely, December 22, 1925, while Part IV of the Act containing certain miscellaneous provisions of minor importance came into operation on February 22, 1926.

Register of Dairy Cattle

VOLUME NINE of the Ministry's Register of Dairy Cattle will be issued during September, and will contain particulars of cows selected for their milk performances during the year ended October 1, 1925. In order to qualify for entry in the Register cows are required to yield not less than the standards prescribed for their breeds or types, as follows:—

Friesian	10,000 lb.
Ayrshire, Blue Albion, Lincoln Red Shorthorn, Red Poll and Shorthorn	9,000 lb.
All other breeds or types ..	8,000 lb.

Owing to the cost of producing the Register it is necessary to limit the number of entries, but it has been found possible to increase the number from 5,000 in volume eight to 7,500 in volume nine. Of these cows 1,623 gave between 9,000 and 10,000 lb. during the year; 2,606 between 10,000 and 11,000 lb.; 1,648 between 11,000 and 12,000 lb.; 774 between 12,000 and 13,000 lb.; 332 between 13,000 and 14,000 lb.; 163 between 14,000 and 15,000 lb.; 194 between 15,000 and 20,000 lb.; and 12 over 20,000 lb. Nineteen recognised breeds or types are represented in the volume, 65 per cent. of the cows being of the Shorthorn type; 18 per cent. Friesian; and 3 per cent. Guernsey.

In addition to the entries mentioned above the Register contains a useful list of cows in respect of which certificates of merit have been issued. These certificates are of value inasmuch as they are evidence of milk yielding and breeding abilities of a cow for a period of three consecutive years. 191 such cows are included in the Register as certified to have given the requisite total yield during the three years ended October 1, 1925, and to have calved not less than three times during that period.

Particulars are also given of pedigree bulls of proved milking strain. The condition of entry of a bull in this section of the register is either (*a*) that its dam and sire's dam have given not less than the standard yield prescribed for their breed or type during a milk recording year, or (*b*) that it has two or more daughters which have given not less than the standard yield prescribed for their breed or type in a milk recording year. In volume nine there are thirty-eight entries, of which twenty-five qualified under condition (*a*) and thirteen under condition (*b*).

The register, in its enlarged form, should be of great

assistance to dairy farmers who are desirous of acquiring animals of proved dairy breeding. Copies of the register will be issued free to all members of milk recording societies and to many agricultural societies and institutions interested in the dairy industry. The sale price of the register is 1s., and copies can be obtained from H.M. Stationery Office at Adastral House, Kingsway, London, W.C. 2, or through any bookseller.

* * * * * *

Edible and Poisonous Fungi

CONTRARY to general belief, the number of kinds of fungi which are really poisonous is comparatively few. It cannot be too strongly emphasized, however, that the only safe method of ascertaining whether a fungus is edible or poisonous is to know its botanical characters, and to be able to distinguish and recognize it just as other plants are recognized. None of the "rule of thumb" methods (as, for instance, the idea that poisonous fungi, when cooking, will blacken a silver spoon) can be relied upon with safety.

The latest of the Ministry's series of Miscellaneous Publications* deals with some of the more common kinds of fungi found in the British Isles.

Twenty-five species (sixteen edible and nine poisonous) are described, purely technical terms being avoided as far as possible. A glossary has been included, however, and this should be of assistance to beginners in the few cases where the use of botanical terms has been found unavoidable. Each example is illustrated by a coloured plate in which a remarkably "true to life" appearance has been obtained. Identification is thus rendered easy and safe, and, armed with the information now made available, it is possible for a savoury addition to be added to the resources of the kitchen for no more than the effort of gathering.

* * * * * *

Ensilage

ENSILAGE has now become an important part of agricultural practice in the British Isles, and shows signs of steady development. A new Miscellaneous Publication,† just published by the Ministry, gives an interesting and detailed account of this method of fodder production and should therefore be of great value to dairy farmers and stock owners generally.

* Miscellaneous Publications, No. 54. Obtainable from the Ministry; prices (post free), quarter boards, 2s. 6d.; S/cloth boards, 3s.

† Miscellaneous Publications, No. 53. Obtainable from the Ministry, prices (post free), cartridge covers, 6d.; quarter bound, 1s.

The Ministry is indebted to Mr. Arthur Amos, M.A., of the School of Agriculture, Cambridge, for the matter dealing with the more practical aspects of the subject, and to Dr. H. E. Woodman of the Animal Nutrition Research Institute, Cambridge, for the chapter on the chemistry of silage.

The subject has been treated in a very thorough manner under the following headings: History of Ensilage and Types of Silage; Suitable Crops; Making Silage in Tower Silos; Clamp Silage; Stack Silage; The Chemistry of Silage; The Feeding of Silage; The Future of Silage. The results of many comparative trials and experiments are given, together with particulars of the costs of production of silage under various conditions.

Mr. Amos is of opinion that there is a real prospect of making ensilage a profitable adjunct to heavy land farming as well as to other districts where roots are unprofitable, not only because it can be produced at a reasonable price, fed economically, lends itself to management on "factory lines," and "fits" with other heavy land management; but because, automatically, it leads to an increase in the fertility of the holding upon which it is grown, through the extra dung which is made when the silage is fed. This is a basis for improving agricultural prosperity, in place of the modern advocacy of the so-called "law of diminishing returns."

Guide to the Conduct of Clean Milk Competitions

MISCELLANEOUS Publication No. 43, "Guide to the Conduct of Clean Milk Competitions," issued by the Ministry in August, 1924, has now been revised in the light of experience gained from the Clean Milk Competitions held. The scheme in its working has given most encouraging results from its inception and has shown no inherent weaknesses. In the second edition of the guide, therefore, the general lines of the original scheme remain unaltered, but several changes have been introduced into the technique to be observed in conducting the bacteriological examination of the milk samples. This second edition is on sale at the Ministry at the price of 4d. (post free), and at this reduced price it is hoped that a copy will be obtained by all milk producers and others interested in Clean Milk Competitions.

A PRELIMINARY statement of the acreage under crops and grass, and number of live stock in England and Wales in 1926, compiled from the annual returns collected on June 4 last, was issued by the Ministry on August 7, and full details will be found on pp. 562-567.

Crops and Live Stock in 1926

* * * * * *

The Milk and Dairies Order, 1926

MILK producers are advised to make themselves acquainted with the provisions of this Order.* The Order comes into force on October 1, 1926, and will be operative throughout the country. With the exception of the regulations dealing with cattle disease, which are to be administered by the county council or county borough council, the Order will be enforced and executed by the sanitary authority.

All cowkeepers (i.e., persons who keep one or more cows for the purpose of the supply of milk) and dairymen are required to be registered by the sanitary authority for their district, together with the premises, including cowsheds, milk stores, etc., which are used for the purpose of the sale or manufacture of milk. If at any time it is proposed to use buildings not hitherto used for the purpose, one month's notice in writing must be given to the sanitary authority.

Certain clauses of the Order specify requirements for the lighting and ventilation of cowsheds and dairies, the provision of a water supply, and the flooring and drainage of cowsheds. In the case of lighting, ventilation, and water supply, eighteen months' " grace " is allowed after the service of a notice relating to buildings in use as cowsheds and dairies on October 1, 1926 ; and in the case of cowshed flooring and drainage, this notice may not be given until April 1, 1928, so that in effect over three years' " grace " is allowed.

As from the date of operation of the Order, milk producers will be required to carry out certain measures intended to secure cleanliness in the production and handling of milk on the farm, and its prevention from disease contamination. Milking must be carried out in " a good and proper light," the udder and surrounding parts of the cow, and the hands of the milker must be cleaned, and milking must be dry-handed as far as practicable. Dung must be removed from milking

* Obtainable from H.M. Stationery Office, Kingsway, London, W.C. 2, price 3d. net.

sheds at least once a day, and cowsheds must be kept always "reasonably clean and sweet," and the walls and ceilings lime-washed or lime-sprayed or otherwise disinfected at least twice a year, in April or May and September or October. Milk vessels and appliances must be kept thoroughly clean, and for this purpose oxidising and preservative agents (*e.g.*, chlorine) are prohibited, except for mechanical milkers and similar appliances. Precautions have to be taken against subsequent contamination or infection of the milk; for example, it must not be kept in a kitchen or living room (except in the case of butter, cream, or cheese manufacture), and the vessels containing it must be kept properly covered. If a person engaged in milking or in handling milk acquires an infectious disease, or has been in contact with an infectious "case," the medical officer of health may require him to keep away from this work until the risk of infecting the milk has passed. Further, if the medical officer has evidence that infectious disease is being conveyed by the milk, he is empowered—subject to certain limitations—to stop the supply for a period or periods of twenty-four hours; but should the notice be proved to be unjustified, compensation may be claimed in respect of loss.

Another clause in the Order requires cowkeepers to cool milk without delay to a temperature not exceeding five degrees Fahrenheit higher than the temperature of the water supply available for cooling. Exceptions are allowed, however (1), where the milk is sent forthwith to a collecting station and there cooled; (2) where the milk is used or sold for the manufacture of butter, cream, cheese, or other milk products; (3) where the milk is delivered to the consumer at least twice daily on the day of production; (4) where the milk is sold for retail delivery immediately after milking. Moreover, this "cooling" regulation does not come into operation until April 1, 1927.

As regards cattle diseases, the Order makes it an offence to sell milk from cows suffering from (1) any comatose condition, (2) any septic condition of the uterus, (3) any infection of the udder or teats which is likely to convey disease. A local authority may serve a notice prohibiting the sale of such milk for a period or periods not exceeding five days.

The above is a brief "lay" summary of the main clauses affecting milk producers, but, as already stated, they will be well advised to procure a copy of the Order and study it for themselves.

UNEMPLOYMENT GRANTS COMMITTEE : STATE ASSISTANCE FOR LAND DRAINAGE WORKS TO JULY 31, 1926

IN a report upon winter land-drainage works, published in the October, 1925, issue of this JOURNAL, a brief reference was made to schemes which had to be certified by the Ministry of Agriculture as works of public utility, and were aided by funds placed at the disposal of the Unemployment Grants Committee. The terms and conditions of the grants were such as would enable Drainage Authorities to secure assistance in obtaining modern pumping plants, sluices and dredgers, and in carrying out drainage works with the use of either mechanical or manual labour. To qualify for aid, such schemes had to be accelerated works that a drainage authority could not wholly afford, but which would relieve unemployment in a necessitous area, either where the works were situated or in the industrial centres where the requisite plant was manufactured.

As most of the schemes in question have been completed, it is now possible to review some of the results obtained and to give an impression of what has been accomplished thereby in the interests of land drainage. It is not proposed to describe here every scheme that has been carried out, but details are given of certain schemes which may be regarded as typical of their particular class.

Fen Pumping Plant.—The most important of these State-assisted works was the provision of modern pumping plant for the Fen country, where the voidance of surplus water from low-lying lands, incapable of gravitational draining, is a vital necessity to the whole community, apart from the very widespread agricultural interests involved. In by-gone days, wind-driven pumps performed (as they still do in some localities) the work of raising, with varying efficiency, the water from the fen drains into the rivers and lodes. It often happens that heavy rain is unaccompanied by wind, so that wind-plant fails to work at the very time it is most urgently needed ; and this has been the unhappy experience of at least one drainage authority, relying on this form of power, during the past winter. In this instance, the old wind-power pump is to be superseded, as it has been in other cases for a similar reason.

Steam plant succeeded wind-power and held sway until comparatively recent times. The average steam plant, however,

although economical for constant running, becomes very expensive when only intermittently used; and, on account of the delay in raising steam, is not quickly available for duty in case of such an emergency as a sudden, heavy rainfall. Moreover, since the War, the stoppage or restriction of coal supplies as a consequence of industrial disputes, has placed areas dependent upon steam plant in a position of great difficulty if not of considerable danger. An even more potent factor affecting steam power in this connexion has been the trebling of the price of coal, involving a large increase in running expenses and the consequent imposition of heavier rates upon the areas drained.

What the increased cost of coal fuel means may be gauged from figures for the Littleport and Downham District, where, years ago, coal for the steam plant (referred to in a later paragraph) was obtainable in large quantities at from 12s. to 12s. 6d. per ton, whereas, to-day, the cost is over £2. In the year 1923, the Commissioners' coal bill was £677, in 1924 it was £829, and in 1925 it amounted to £2,175. During the six months ended March 31, 1926, this steam plant had run 943 hours and approximately 500 tons of coal, costing about £1,000, were used.

The natural tendency has been, therefore, to replace the steam plants by oil-driven, internal combustion engines, as a measure of economy both in fuel and the intermittent use of power. And with this change of method in producing power has come, also, an entire alteration in the manner of its application. In both the wind-power and early steam plants, the scoop wheel held place and was capable of excellent performances, but the subsidence of the drained fens was a difficult factor to overcome, since an increase in the diameter of the wheel invariably placed too great a load on the power unit, and decreased the efficiency of the whole plant.

The steam-driven vertical spindle pump and the steam-driven centrifugal pump followed in succession to the scoop wheel, but the modern combination, giving a maximum in efficiency and reliability, is the oil-driven centrifugal pump. In this connexion, Figs. 1 and 3, from photographs taken recently at Lakenheath Fen, will be of interest as showing the earliest and latest forms of pumping plant.

In the foreground of Fig. 1 can be seen the obsolete wind-driven scoop wheel; in the middle distance is seen the steam driven scoop wheel now superseded, but still capable of rendering service if required. The modern plant, which is

visible just beyond the steam plant, is also shown in detail in Fig. 3. This plant, erected with State aid, drains an area of 3,397 acres, and consists of a Vickers-Petters two-cylinder engine of 180 h.p., coupled to a Gwynnes' 36 in. centrifugal pump, which, delivering against a 12 foot head, has a discharge capacity of 100 tons per minute. The plant is erected upon a substantial concrete foundation, supported upon piles of 25 feet depth.

A more powerful plant, illustrated in Figs. 2 and 4, has been erected in the Littleport and Downham District as an auxiliary station to assist in the drainage of an area of 28,600 acres. In this case a more attractive and substantial brick building was erected upon pile and concrete foundations to house the plant. The original plant in this area, installed in 1830, comprised a steam-driven scoop wheel of exceptional size, 50 ft. diameter, believed to be the largest example of its type. This was, however, replaced, in 1914, by a new steam-plant directly coupled to a centrifugal pump, which did its work well but, if anything, was too powerful and too expensive for the job. In consequence, the Drainage Commissioners desired to have an alternative stand-by plant which could be used for ordinary pumping work, and leave the steam plant to deal with exceptional floods and heavy rainfalls.

The new plant installed consists of a Mirrlees five-cylinder Diesel engine of 250 h.p., directly coupled to a 36 in. Gwynnes' centrifugal pump, capable of delivering 100 tons of water per minute under the worst possible conditions, *i.e.*, with low water in the drain and high water in the river, or against a head of 25 feet; or, when working under normal conditions, of delivering 110 tons per minute with a head of about 20 feet. These figures were fully substantiated during a short test conducted by Mr. E. J. Silcock, M.Inst.C.E., consulting engineer for the plant, when the cost of oil fuel proved to be 5s. 6d. per hour as against £1 for coal per hour with the steam plant. The new oil-driven plant can be started in fifteen minutes, whereas several hours are required to raise steam for the older installation.

On a stone tablet over the main entrance to the old engine house is the date 1830 and the following lines:—

"These fens have oft-times been by water drowned,
Science a remedy in water found;
The power of steam, she said, shall be employed,
And the destroyer by itself destroyed."

Appropriate enough, it will be conceded, was this verse for the period in which it was set up ; but, to-day, even steam, despite its reliability, has to give way to oil, not through lack of efficiency, but on account of the all-important factor —economy.

Particulars of various pumping plants erected with aid from the Unemployed Grants Committee are, for convenience, given in the accompanying tabulated statement.

Dredging.—The provision of dredging plant, together with the execution of dredging work on arterial channels, was another important type of drainage work financed by means of grants in aid ; but the restrictions attaching to the sanction of grants precluded any development of this work on a large scale. Many areas could not be classed as necessitous from the point of view of unemployment, and few drainage authorities can afford, in these days, to purchase new plants and undertake large schemes without substantial assistance.

A dredger acquired by the Middle Level Commissioners is shown in Figs. 6 and 7, at work on their main drain. This plant, manufactured by Messrs. Ransomes and Rapier, Ltd., is much larger and more powerful than any similar plant previously acquired by the Commissioners. It has rendered economical and efficient service since November 6, 1925, upon a scheme involving extensive dredging on the Middle Level Main Drain, an average number of fifty unemployed men being engaged, over a period of seven months, spreading and levelling the spoil deposited on the banks. The dredger, which cost £4,285, has a steel pontoon, 55 ft. long and 25 ft. beam. The gib has a working radius of 55 ft. and the capacity of the grab bucket is 20 cubic feet.

Drainage Sluices.—The reconstruction and improvement of drainage outfall is an important responsibility of many drainage authorities, and, in common with all under-water work, is usually difficult and costly.

Figs. 8 and 9 show the important Middle Level Sluices at St. Germains, River Ouse, where each of the three eyes has now been fitted with modern stoney sluices, replacing the old pointing doors. This improvement was essential, not only to give a greater discharge capacity to this drainage outfall from about 150,000 acres of land, but also to provide a means of arresting a very serious deposition of silt on the tidal or river side of the structure.

The original sluice structure was erected in 1847 at the confluence of the newly-excavated main drain and the River Ouse. In the year 1862, this sluice "blew up," permitting the tidal waters to enter the main drain, breach the drain embankments, and inundate several thousand acres of valuable land. After a period, during which a scheme of syphonage over a coffer dam was tried and proved unsatisfactory, through silting-up on the tidal side, the existing sluice structure was erected in 1875, not on the site of the original one, but about half a mile upstream along the main drain. This change of site was adopted, doubtless, with the idea that foundation failures, as in 1862, would thereby be precluded, but it has, nevertheless, proved to be unfortunate.

The sluice acted fairly well for many years but, in course of time, the outfall channel to the Ouse, and the river itself, became silted up, and dredging the channel below the sluice, when last attempted in 1912, proved ineffective. With the shortage of labour, matters went from bad to worse during the War, and the river lapsed into an almost unbelievable state through neglect. This affected the Middle Level outfall channel to such an extent that, during the abnormally dry summer of 1921, the swinging gates of the sluice could not be opened for four months, being held fast by 13 feet depth of silt against them on the river side. The silt was, in fact, at a higher level than the water in the drain above the sluice.

As this unsatisfactory state of affairs jeopardised the safety of the drainage area of 120,000 acres, the Commissioners at length decided to adopt a scheme of their engineer, Major R. G. Clark, M.Inst.C.E., under which the old doors would be replaced by half-tide stoney sluices, to act in conjunction with half-tide reinforced concrete bulk heads; and two of the three sluices were reconstructed with the assistance of grants from the Unemployment Grants Committee. This scheme not only saved in initial cost, but it will ensure economy in case of future renewals. Another advantage gained by placing the new stoney sluices on the river side is the effective scour this arrangement gives on the banks of silt that pile up periodically against the sluices. A total sluicing width of 51 feet is now provided by the three new sluices, whereas the old timber gates only allowed a total sluicing width of 40 feet. Apart from the labour employed in the industrial area where the sluice gear was manufactured, the actual erection of the two sluices that were assisted by grant, provided thirty men with employment on the site for about sixteen months.

At Salter's Lode Lock, Middle Level, work is in progress, as shown in Fig. 10, for strengthening the structure and fixing new doors. Four pairs of doors were in a very decayed condition, and the walls of the lock were caving-in on the tidal side, threatening a collapse of the whole fabric, thus exposing the low-lands of the level to the danger of a tidal inundation from the River Ouse. The work, which was eligible for grant up to August 31, 1926, has given employment to twenty-one men since January, 1926.

Grants for Drainage Schemes.—Since the reference in the October, 1925, issue of this JOURNAL, the Ministry has been able to certify nineteen further schemes, but, for various reasons, including the restriction of Unemployment Grants, only ten of these have been put into operation. The ten schemes have provided an additional 1,200 men with direct employment for several months at a total cost of £29,400. The amount of indirect employment provided in industrial centres is difficult to ascertain, but it may be taken as very considerable, the bulk of the money being expended upon new plant, affording employment in every stage of its manufacture.

It should be noted here that although State aid to drainage schemes, as a means of relieving unemployment, has now ceased, His Majesty's Government have, as part of their agricultural policy, allocated a substantial sum of money, spread over the next five years, for grants in aid of land drainage.

These grants, which are only available for approved major schemes, conferring a wide benefit on agricultural land, undertaken by a drainage authority, permit of works such as described in this article proceeding during any period of the year, by direct labour, piece-work, or contract, and by the most economical means. The use of mechanical plant for such works is unrestricted, but it is stipulated that all new plant and materials must be of British manufacture The full terms and conditions attending these grants have been circulated to all drainage authorities in a Circular Letter, No. L.D. 6220/C.L., dated March 13 last.

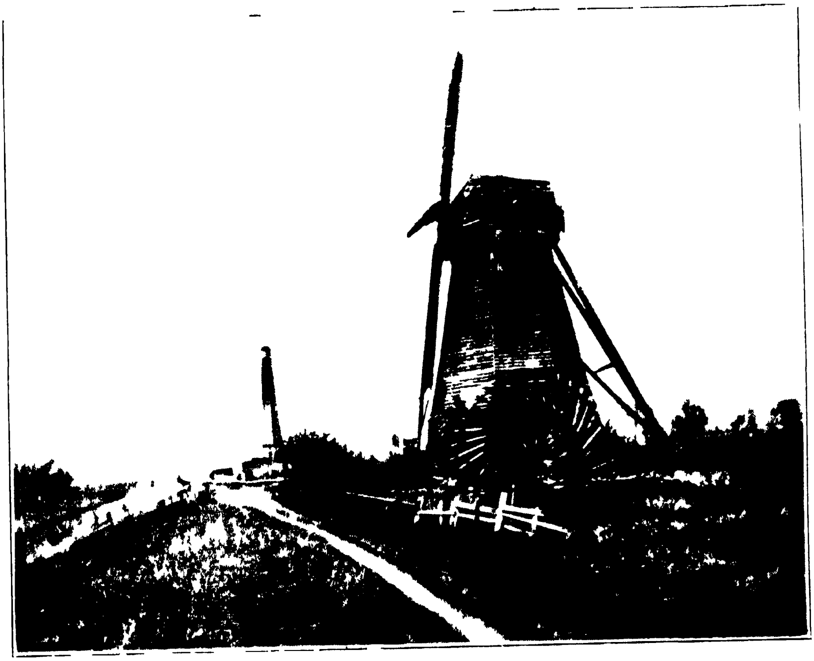
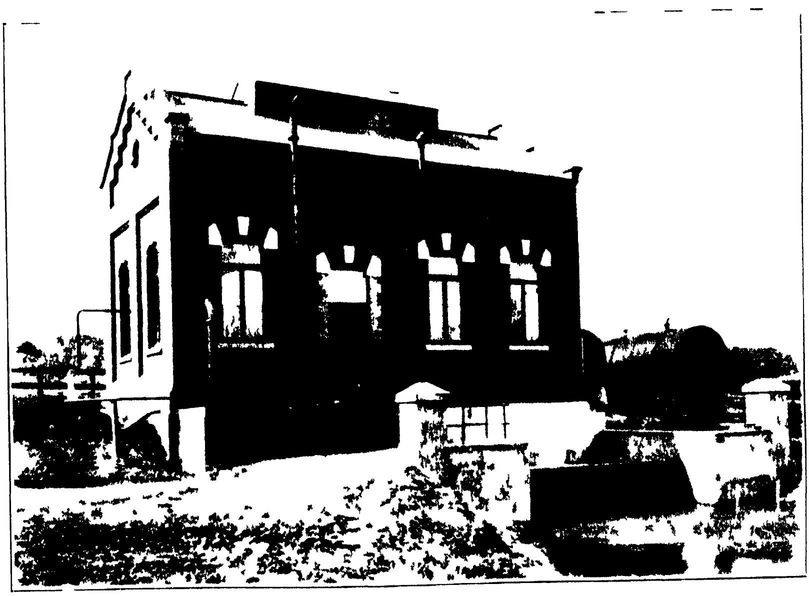


Fig. 1.—[illegible] View showing [illegible] new pumping plant



[illegible] [illegible]

Fig. 2.—Littleport and Downham Fen. View of new pump house showing draining sump.

[illegible] 194

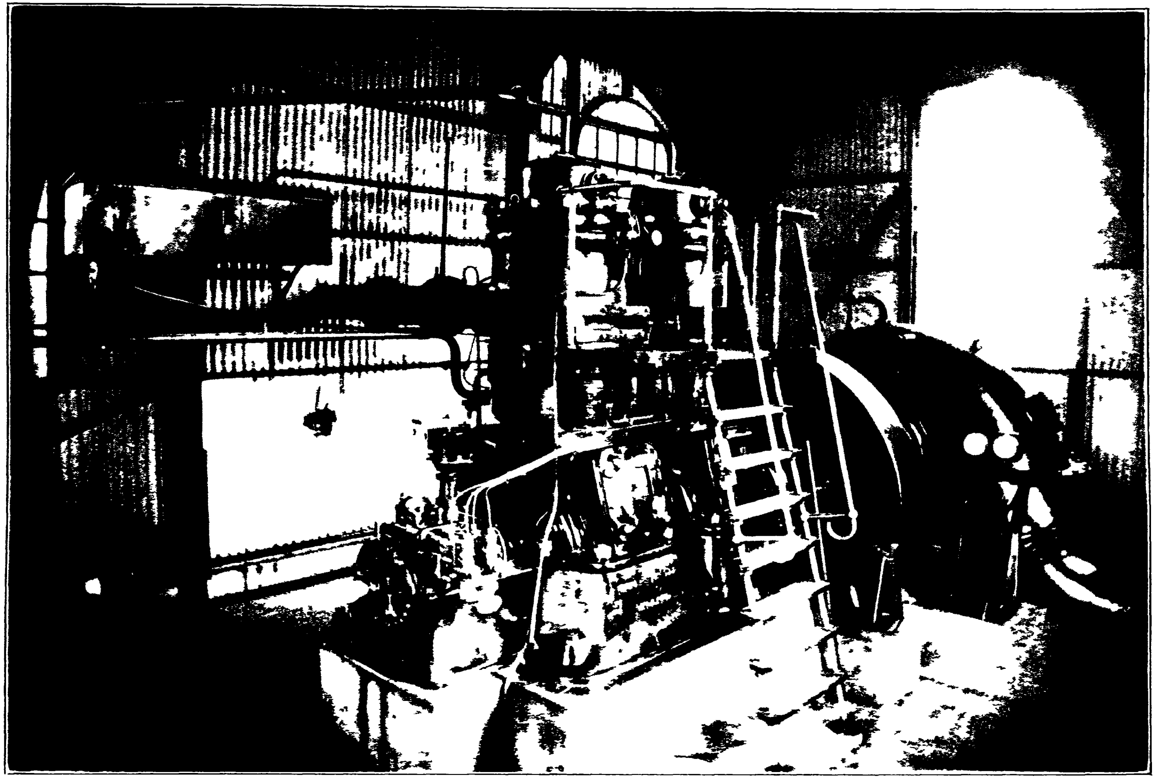


Fig. 3. [illegible] Bath and Broadwater. Interior of pumphouse

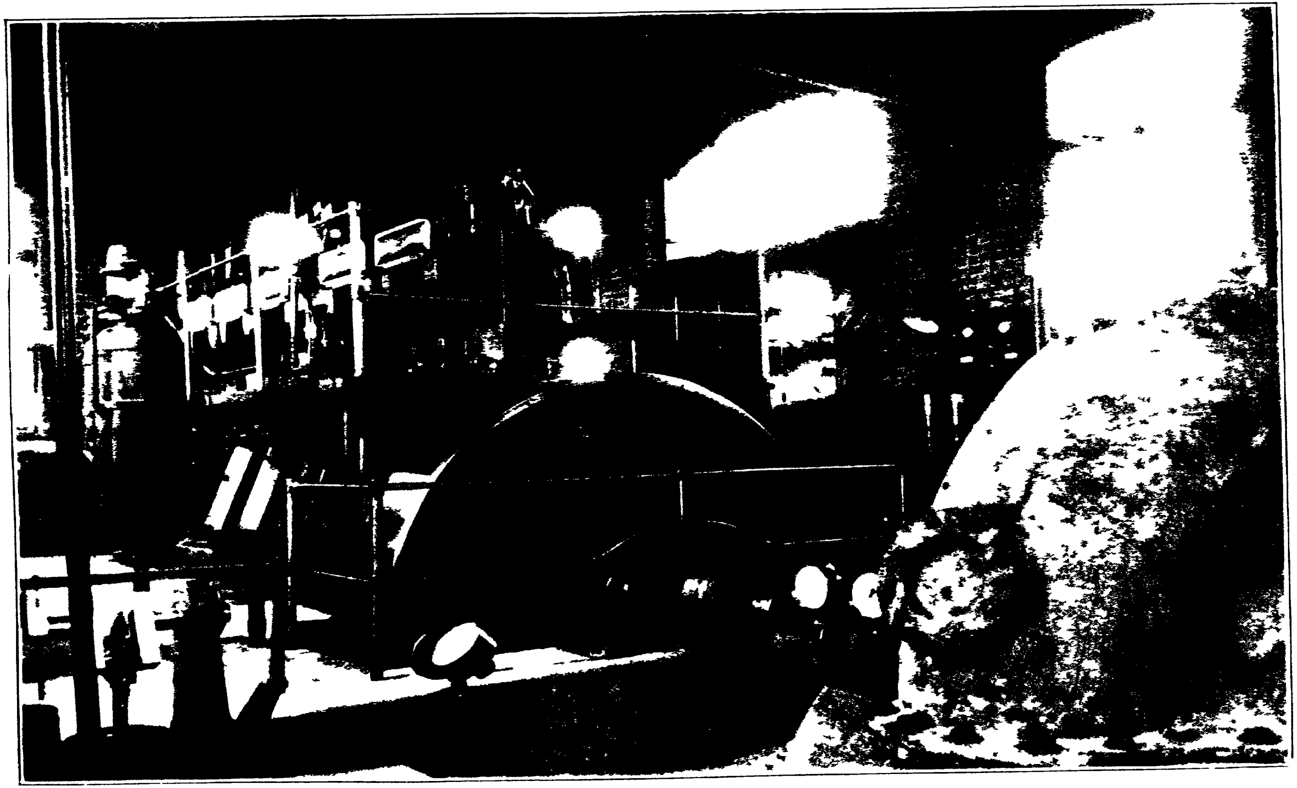
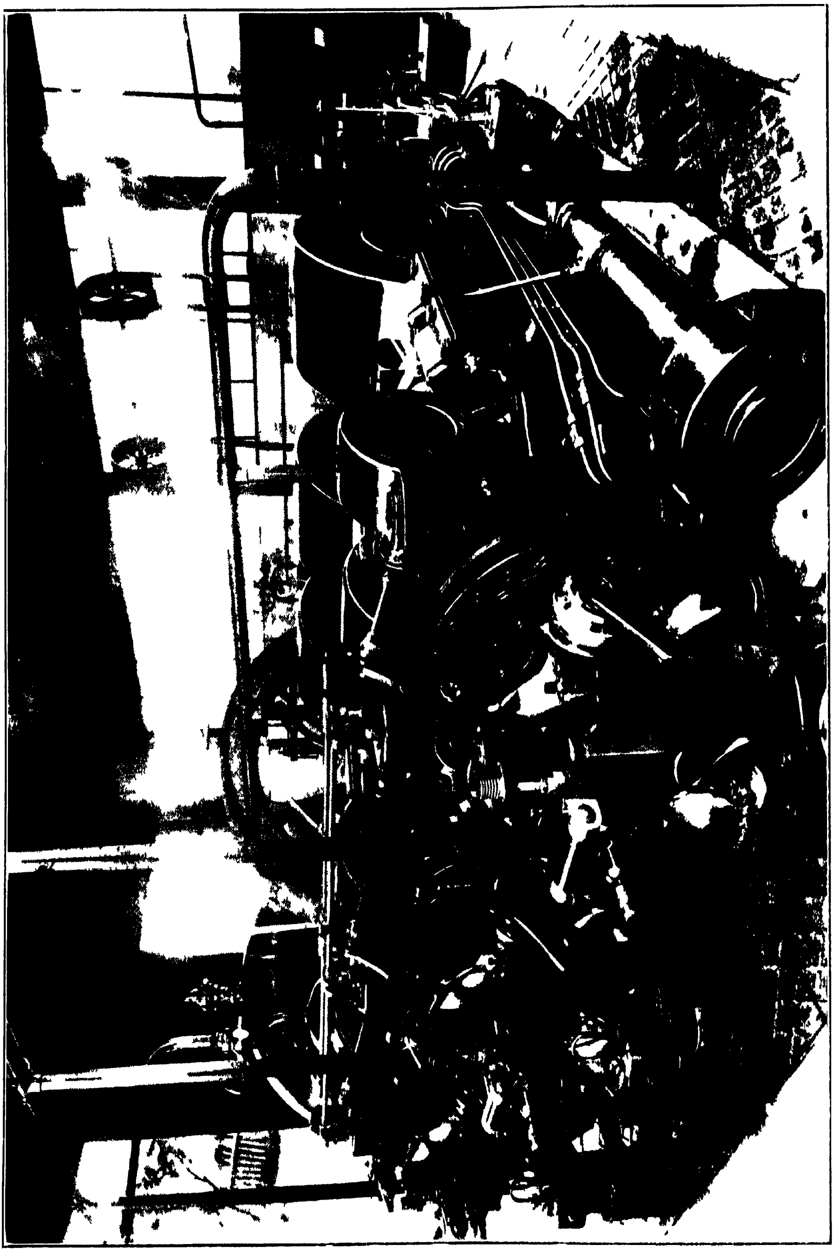


FIG. 4. Littleport and Downham Fen. Interior of pump house



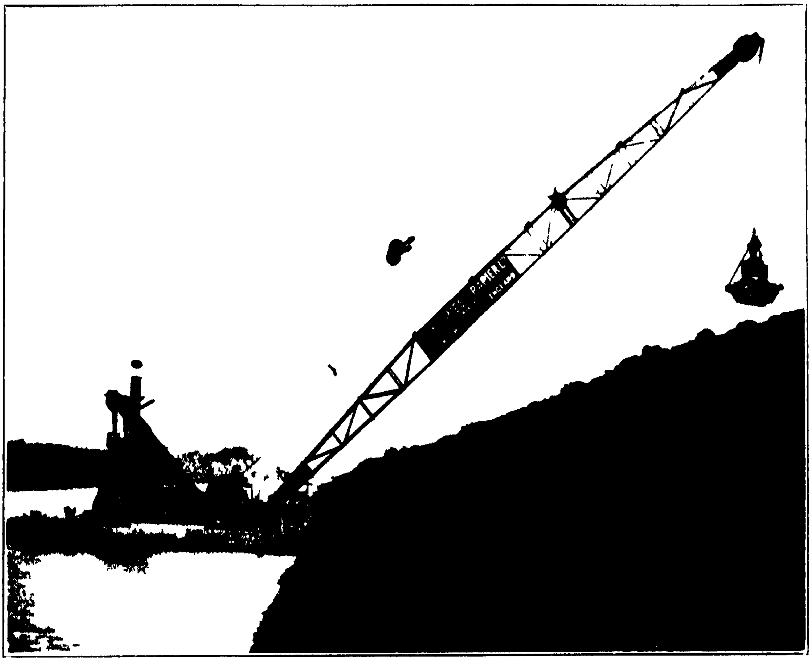


Fig. 6. Middle Level. New dredger at work [illegible]

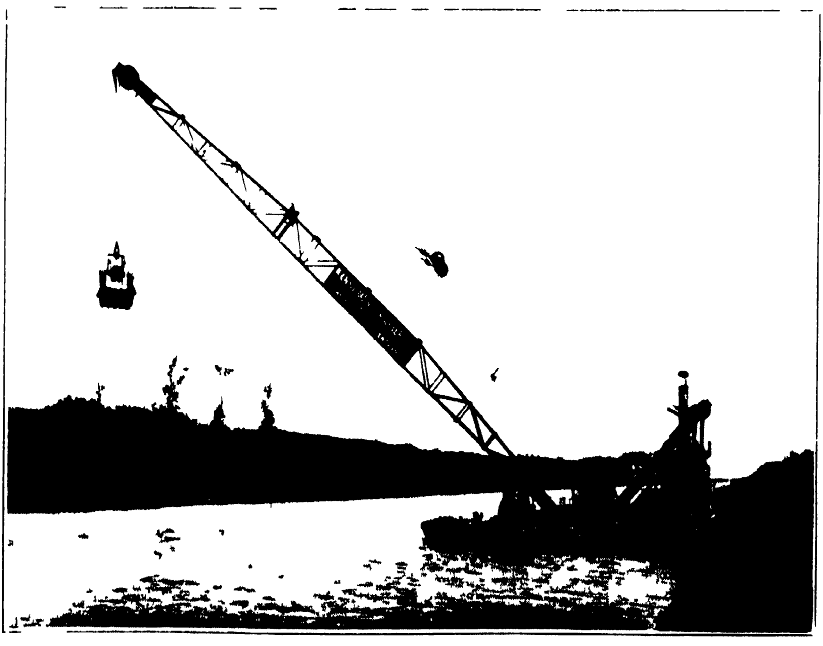


Fig. 7. Middle Level. Another view of dredger showing [illegible] working [illegible]

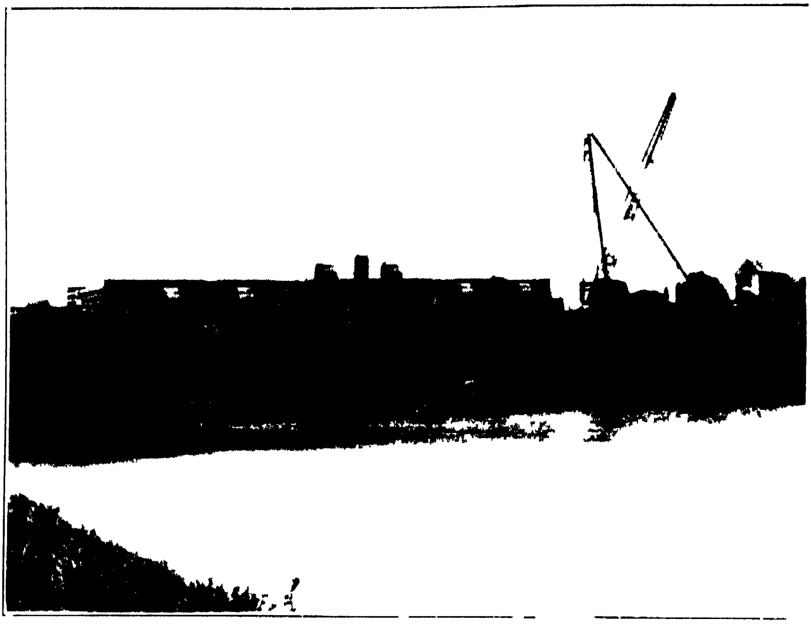


Fig. 8. Middle Level Sluice, St. Germans. View [illegible]

Fig. 9. Middle Level Sluice, St. Germans. View of control gear

Fig. 10. [illegible]

FEN PUMPING PLANTS ERECTED WITH AID OF U G C GRANTS

Name of drainage district	Area in acres	Type of plant	Approximate cost (with housing, cost where applicable)	Pumping head in feet	Capacity of plant Tons per minute	Remarks
Soham and Middle Fen	11,488	Mirrlees 5-cylinder Diesel engine 250 horse power. Allens' 42″ centrifugal pump	£6,202 (existing engine house)	18½	140	
Littleport and Downham Fen	28,663*	Mirrlees' 5-cylinder Diesel engine 250 horse power Gwynnes' 36″ centrifugal pump	£11,003 (new house)	20	110	*This area is drained by means of pumping plants on the Hundred Foot River and on the Ten-Mile River
Waterbeach Level	4,986	Mirrlees 4-cylinder Diesel engine 184 horse power Gwynnes' 42″ centrifugal pump	£5,700 (Approx)	12	150	
Burnt Fen	14,304	*Two pumping sets* each Blackstones' 3-cylinder horizontal engines 250 horse power Gwynnes' 42″ centrifugal pumps	£12,000 (Approx)	17	150 each	See Fig. 5
Feltwell and Southery Drainage District	13,644	Mirrlees 4-cylinder Diesel engine 180 horse power Gwynnes' 36″ centrifugal pump	£4,000 (Approx)	20	102 5	Assists Hockwold plant in draining whole area
Lakenheath and Brandon Fen	3,397	Vickers - Petters' 2 - cylinder engine 180 horse power Gwynnes' 36″ centrifugal pump	£5 500 (Approx)	12	100	
Mildenhall Fen	6,753	Vickers - Petters' 2 - cylinder engine 180 horse power Gwynnes' 40″ centrifugal pump	£5,500 (Approx)	9	135	
	83,235	Acres	£53,905			

NITROGENOUS MANURING OF PASTURE

THE question of improving our pastures and securing the highest possible yield from them is of very considerable importance. For many years past it has been held that the basis of the improvement of pastures is the application of phosphates, the development of white clover, and adequate stocking. The direct use of nitrogen on pastures was held to be harmful. In view of recent German experiments, however, guided by Dr. Warmbold, it becomes a question how far we in Great Britain are justified in neglecting the use of nitrogenous manures as a means of increasing the output from pasture land. It may serve a useful purpose to give here a few notes on the work being done in Germany, as seen by one of the Ministry's officers who recently visited Hohenheim.

The Hohenheim Station is situated on high ground—about 1,200 feet above sea level—some six miles from Stuttgart, and extends to about 1,000 acres. It is the headquarters of several schools, including an agricultural high school, a horticultural school, a small-holders' school, and institutes for plant breeding and animal nutrition.

For two and a-half years during the war, Dr. Warmbold was the head of this important establishment, leaving it to become Minister of Agriculture for Prussia. Urged to increase production, and with no State funds at his disposal, he conceived the idea of increasing the output from grassland. About sixty-nine acres of pasture were divided into ten enclosures of from four to ten acres each, two strands of barbed wire and posts at three-yard intervals being used for fences. After ten years these fences are still intact. A plentiful supply of running water was diverted so as to serve two adjacent fields in turn.

Up to 1916, when the experiment started, an area of 1·4 acres was required for the maintenance of 1 cow of 1,100 lb. weight from the end of April to the beginning of October. From the winter of 1916-17 onwards the pastures have been manured with 107 lb. per acre per annum of pure nitrogen (equivalent to 5 cwt. of sulphate of ammonia) besides phosphate and potash. At the beginning of the treatment 36 lb. of phosphoric acid (P_2O_5) and 80 lb. of potash (K_2O) were applied per acre, equivalent to about 260 lb. of superphosphate (30 per cent.) and 200 lb. of 40 per cent. potash salts. In the following years the phosphates and potash were reduced, but

the amount of nitrogen remained the same. Basic slag may be substituted for superphosphate, and part of the nitrogen may be given in the form of nitrate of lime or urea.

The phosphates and potash are applied in the autumn: one-half of the nitrogenous dressing in the form of sulphate of ammonia is given about February 1, and the other half in three separate applications, usually as urea, in May, June, and July. For summer applications urea seems to have special advantages not yet properly understood. Lime at the rate of about 900 lb. per acre is applied at intervals of six years.

The effect of this heavy manuring was seen in 1917, when an area of $\frac{3}{4}$ acre was sufficient for 1 cow. From 1918 onwards $\frac{1}{2}$ acre per cow sufficed.

During Dr. Warmbold's time 69 acres carried from April to October 56 cows and 20 store stock, and of this area 38 acres were cut for hay in May and June. In 1918 the average yield of milk per acre was 445 gallons, and this was obtained from the dun and white German breed, which is primarily kept for draught purposes.

In order to secure the full nutritive capacity of a pasture the grass must be utilized in its leafy stage. Under this system of manuring growth starts earlier in spring, and must be stocked earlier. If the head of stock is insufficient to keep down the vigorous growth, part of the pastures should be cut for hay. The large number of enclosures provide a reserve which can be grazed or mown according to circumstances.

The first bite off each enclosure is reserved for the best milking cows. After two or three days on a plot these are followed by lower yielding cows, or by dry cows and store cattle. This sequence is followed round the whole series, provision being made for each plot to have ten to twelve days' rest without stock of any kind.

At the date of the visit the 69 acres were carrying 56 cows in milk, of the Allgauer Braunvieh breed, followed by 7 dry cows and 4 horses. (This breed is in some respects akin to the Jersey, but is much heavier in flesh and bone. It is reputed to yield more and richer milk than the more common draught cow of Germany.) Three enclosures had been cut for hay. It was, however, evident that the plots had got out of hand and that at least 50 per cent. more stock could have been carried.

Circumstances this year prevented the carrying out of Dr. Warmbold's scheme in its entirety. Nevertheless the plots were intensely interesting. The soil is Keuper marl,

heavy and sticky under arable conditions, and the average annual rainfall is about 26 in. The predominant grass is perennial rye-grass. Other grasses well represented are cocksfoot and rough-stalked meadow grass, and occasional plants of meadow fescue, Timothy and crested dogstail are also seen. Weeds, such as bent and Yorkshire fog are rare.

Over all there is a liberal distribution of sturdy, vigorous white clover. It is perfectly clear that this system of manuring, combined with grazing and mowing, is not detrimental to white clover. The early spring grazing keeps the grasses in check, the occasional mowing mitigates the smothering effect of luxuriant grass, and the heavy treading tends to reinforce a combination of circumstances well suited to the development of clover.

Doubts have been expressed as to how far the results obtained by Dr. Warmbold were due to improved methods of pasture management, and how far, if at all, to nitrogenous manuring. The most sceptical, however, after seeing Dr. Warmbold's plots, would be convinced that no system of management which omitted the use of nitrogenous manures could produce such luxuriant herbage as that at Hohenheim; and the effect cannot be attributed to manurial residues of feeding stuffs, because no cake or corn is fed to the cows in summer, whatever their milk yield may be. The herd at the moment includes 1,000-gallon cows and several cows giving four to five gallons a day, and there is no indication of any need for "production" rations. The whole herd was in remarkably fresh and vigorous condition.

In connexion with this system, the British farmer will at once see certain practical difficulties, the first being that of deciding upon the requisite number of stock. Farmers, as a rule, play for safety. They dread a shortage of keep. If pastures are stocked heavily enough in the early stages to keep the grass continuously short there might be scarcity should a spell of drought supervene. To provide against such an eventuality it is necessary to have certain areas in reserve which may be mown if not required as pasturage. Under a system of nitrogenous manuring, however, the effects of drought are less likely to be felt severely than under the ordinary system, owing to deeper rooting of the grasses, the quick response they make to favourable growing conditions, and the dense canopy of vegetation they form over the soil.

For making hay out of season (and also for making clover hay in the ordinary course) the Germans adopt a method of

drying in "huts." Three poles, usually thinnings, are fastened together at the top by a wire and erected as a tripod. Cross pieces of wood are then fastened to the poles, and on these the partially made hay is piled in the form of a cock. It is maintained that hay dried in this fashion has a feeding value equal to that produced by sun and wind, as rain passes through quickly and does not wash out the food constituents.

Perhaps an even greater difficulty is the fouling of the pasture by the close stocking. As the stock are moved on it is necessary to spread their droppings, and in a dry spell the smearing caused by harrows will not be obliterated so long as dry weather lasts. At Hohenheim the droppings were collected by shovel and distributed in the winter, but this method may not be practicable in this country. A possible solution would lie in a middle course between the usual extensive grazing and the intensive system of very small plots with its heavy stocking and frequent changes.

An opportunity has been given of examining an experiment now being conducted at Melchet Court, Hants., by the British Sulphate of Ammonia Federation. An area of 9½ acres was portioned off in fenced plots of 1 to 1½ acres in April last, when the manures were applied for the first time, and up to the present this area, run on Hohenheim lines, has carried 23 dairy cows and 15 Welsh bullocks. The ground, however, is now becoming foul and smeared, and it will be necessary to reduce the head of stock or provide additional pasturage.

The outstanding feature of this experiment is that the clovers have been strengthened rather than eliminated. Furthermore, the characteristic effect of nitrogenous manures —glaucous, dark green leaves—is well seen on the herbage.

One adaptation of the German system that would doubtless appeal to many farmers would be the provision of early spring keep for ewes and lambs. The close grazing thereby induced would keep down the grasses and let the clovers have a chance. This grazing might be followed by a hay crop cut before the grasses became strong enough to smother the white clover, and the aftermath might then be grazed by dairy cows. The grassland sheep farmer of the south should aim at getting a considerable proportion of his lambs off fat by the end of May, and the adaptation referred to should enable him to accomplish this object.

Owing to his rigorous winter the German farmer is limited to summer grazing. In many parts of England stock are out all the year round. It would be a distinct gain, particularly

to the sheep farmer, if he could count upon a greater abundance of winter or even of earlier spring keep.

There are many other cases in which the German system might be adopted with good chances of success. Wherever the area of grass is small for the number of stock carried, as, for example, on Institutional farms requiring large supplies of milk, the heavy manuring of the restricted pasturage should do away with soiling and other laborious and expensive methods of feeding, and so enable the extravagant milk-and-feed system to be modified in favour of breeding and rearing. Generally, it should enable farmers to undertake, probably with financial advantage to themselves, a little more arable cultivation.

There are many interesting things at Hohenheim besides the grass plots. On the basis of area grass is the least important crop. The whole country around is predominantly arable in a very high state of cultivation. Corn and beans in particular were absolutely full crops, and though of great length were mostly standing erect and free from rust, aphides, and other pests.

Cultivations and manuring are both directed to secure continuous, gradual, uniform growth throughout the season. Much attention is given to "balancing" the manurial dressings. Under good conditions of fertility, the normal proportions are 23 of nitrogen, 15 of phosphoric acid, and 30 of potash, or approximately, 1 of sulphate of ammonia, 1 of superphosphate, and 2 of kainit. Under lower conditions the proportions are 23 of nitrogen, 69 of phosphoric acid and 57 of potash, or 1 of sulphate of ammonia, 3 of superphosphate, and 4 of kainit. This is rather contrary to our own methods of standard quantities of phosphate and potash and varying amounts of nitrogen. The Germans contend that only by a right apportionment of manurial ingredients can normal, healthy growth and disease-resistance be obtained. Having regard to economic conditions they believe in liberal manurial dressings when all conditions are good and the soil fertile, and lesser quantities for poor soils or poor conditions.

* * * * * *

THE ARRANGEMENT OF FIELD EXPERIMENTS

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The Present Position.—The present position of the art of field experimentation is one of rather special interest. For more than fifteen years the attention of agriculturalists has been turned to the *errors* of field experiments. During this period, experiments of the uniformity trial type have demonstrated the magnitude and ubiquity of that class of error which cannot be ascribed to carelessness in measuring the land or weighing the produce, and which is consequently described as due to " soil heterogeneity " ; much ingenuity has been expended in devising plans for the proper arrangement of the plots ; and not without result, for there can be little doubt that the standard of accuracy has been materially, though very irregularly, raised. What makes the present position interesting is that it is now possible to demonstrate (*a*) that the actual position of the problem is very much more intricate than was till recently imagined, but that realising this (*b*) the problem itself becomes much more definite and (*c*) its solution correspondingly more rigorous.

The conception which has made it possible to develop a new and critical technique of plot arrangement is that an estimate of field errors derived from any particular experiment may or may not be a valid estimate, and in actual field practice is usually not a valid estimate, of the actual errors affecting the averages or differences of averages of which it is required to estimate the error.

When is a Result Significant?—What is meant by a valid estimate of error? The answer must be sought in the use to which an estimate of error is to be put. Let us imagine in the broadest outline the process by which a field trial, such as the testing of a material of real or supposed manurial value, is conducted. To an acre of ground the manure is applied; a second acre, sown with similar seed and treated in all other ways like the first, receives none of the manure. When the produce is weighed it is found that the acre which received the manure has yielded a crop larger indeed by, say, 10 per cent. The manure has scored a success, but the confidence with which such a result should be received by the purchasing

public depends wholly upon the manner in which the experiment was carried out.

The first criticism to be answered is—"What reason is there to think that, even if no manure had been applied, the acre which actually received it would not still have given the higher yield ?" The early experimenter would have had to reply merely that he had chosen the land fairly, that he had no reason to expect one acre to be better than the other, and (possibly) that he had weighed the produce from these two acres in previous years and had never known them to differ by 10 per cent. The last argument alone carries any weight. It will illustrate the meaning of tests of significance if we consider for how many years the produce should have been recorded in order to make the evidence convincing.

First, if the experimenter could say that in twenty years experience with uniform treatment the difference in favour of the acre treated with manure had never before touched 10 per cent., the evidence would have reached a point which may be called the verge of significance ; for it is convenient to draw the line at about the level at which we can say: "Either there is something in the treatment, or a coincidence has occurred such as does not occur more than once in twenty trials." This level, which we may call the 5 per cent. point, would be indicated, though very roughly, by the greatest chance deviation observed in twenty successive trials. To locate the 5 per cent. point with any accuracy we should need about 500 years' experience, for we could then, supposing no progressive changes in fertility were in progress, count out the twenty-five largest deviations and draw the line between the twenty-fifth and the twenty-sixth largest deviation. If the difference between the two acres in our experimental year exceeded this value, we should have reasonable grounds for calling the result significant.

If one in twenty does not seem high enough odds, we may, if we prefer it, draw the line at one in fifty (the 2 per cent. point), or one in a hundred (the 1 per cent. point). Personally, the writer prefers to set a low standard of significance at the 5 per cent. point, and ignore entirely all results which fail to reach this level. A scientific fact should be regarded as experimentally established only if a properly designed experiment *rarely fails* to give this level of significance. The very high odds sometimes claimed for experimental results should usually be discounted, for inaccurate methods of estimating error

have far more influence than has the particular standard of significance chosen.

Since the early experimenter certainly could not have produced a record of 500 years' yields, the direct test of significance fails; nevertheless if he had only ten previous years' records he might still make out a case, if he could claim that under uniform treatment, the difference had never come *near* to 10 per cent. His argument is now much less direct; he wishes to convince us that such an error as 10 per cent. would occur by chance in less than 5 per cent. of fair trials, and he can only appeal to ten trials. On the other hand, for those ten years he knows the actual value of the error. From these he can calculate a standard error, or rather an estimate of the standard error, to which the experiment is subject; and, if the observed difference is many times greater than this standard error, he claims that it is significant. At how many times greater should he draw the line? This factor depends on the amount of experience upon which the standard error is based. If on ten values, we look in the appropriate published table for "the 5 per cent. value of t, when $n=10$" and find (1 p. 137) the value 2·228. If, then, the standard error is only 3 per cent., the 5 per cent. point is at 6·684 per cent., and we can admit significance for a difference of 10 per cent.

If we thus put our trust in the theory of errors, all the calculation necessary is to find the standard error. In the simple case chosen above (in which, for simplicity, it is assumed that each of the two acres beats the other equally often) all that is necessary is to multiply each of the ten errors by itself, thus forming its square, to find the average of the ten squares and to find the square root of the average. The average of the ten squares is called the variance, and its square root is called the standard error. The procedure outlined above, relying upon the theory of errors, involves some assumptions about the nature of field errors; but these assumptions are not in fact disputed, and have been extensively verified in the examination of the results of uniformity trials.

Measurement of Accuracy by Replication.—It would be exceedingly inconvenient if every field trial had to be preceded by a succession of even ten uniformity trials; consequently, since the only purpose of these trials is to provide an estimate of the standard error, means have been devised for obtaining such an estimate from the actual yields of the trial year.

The method adopted is that of replication. If we had challenged, as before, the result of an experiment performed, say, ten years ago, we should not probably have been referred to the experience of previous years, but should have learnt that each trial acre was divided into, say, four separate quarters; and that the two acres were systematically intermingled in eight strips arranged ABBAABBA, where A is the manured portion, and B the unmanured.*

Besides affording an estimate of error such intermingling of experimental plots is of value in diminishing the actual error representing the difference in actual fertility between the two acres. For it is obvious that such differences in fertility will generally be greater in whole blocks of land widely separated, than in narrow adjacent strips. This important advantage of reducing the standard error of the experiment has often been confused with the main purpose of replication in providing an estimate of error; and, in this confusion, types of systematic arrangement have been introduced and widely employed which provide altogether false estimates of error, because the conditions, upon which a replicated experiment provides a valid estimate of error, have not been adhered to.

Errors Wrongly Estimated.—The error of which an estimate is required is that in the difference in yield between the area marked A and the area marked B, *i.e.*, it is an error in the difference between plots treated differently in respect of the manure tested. The *estimate* of error afforded by the replicated trial depends upon differences between plots treated alike. An estimate of error so derived will only be valid for its purpose if we make sure that, in the plot arrangement, pairs of plots treated alike are not nearer together, or further apart than, or in any other relevant way, distinguishable from pairs of plots treated differently. Now in nearly all systematic arrangements of replicated plots care is taken to put the unlike plots as close together as possible, and the like plots consequently as far apart as possible, thus introducing a flagrant violation of the conditions upon which a valid estimate is possible.

One way of making sure that a valid estimate of error will be obtained is to arrange the plots deliberately at random,

* This principle was employed in an experiment on the influence of weather on the effectiveness of phosphates and nitrogen alluded to by Sir John Russell (3). The author must disclaim all responsibility for the design of this experiment, which is, however, a good example of its class.

so that no distinction can creep in between pairs of plots treated alike and pairs treated differently; in such a case an estimate of error, derived in the usual way from the variations of sets of plots treated alike, may be applied to test the significance of the observed difference between the averages of plots treated differently.

The estimate of error is valid, because, if we imagine a large number of different results obtained by different random arrangements, the ratio of the real to the estimated error, calculated afresh for each of these arrangements, will be actually distributed in the theoretical distribution by which the significance of the result is tested. Whereas if a group of arrangements is chosen such that the real errors in this group are on the whole less than those appropriate to random arrangements, it has now been demonstrated that the errors, as estimated, will, in such a group, be higher than is usual in random arrangements, and that, in consequence, within such a group, the test of significance is vitiated. It is particularly to be noted that those methods of arrangement, at which experimenters have consciously aimed, and which reduce the real errors, will appear from their (falsely) estimated standard errors to be not more but less accurate than if a random arrangement had been applied; whereas, if the experimenter is sufficiently unlucky, as must often be the case, to *increase* by his systematic arrangement the real errors, then the (falsely) estimated standard error will now be smaller, and will indicate that the experiment is not less, but more accurate. Opinions will differ as to which event is, in the long run, the more unfortunate; it is evident that in both cases quite misleading conclusions will be drawn from the experiment.

A Necessary Distinction.—The important question will be asked at this point as to whether it is necessary, in order to obtain a valid estimate of error, to give up all the advantage in accuracy to be obtained from growing plots, which it is desired to compare, as closely adjacent as possible. The answer is that it is not necessary to give up any such advantage. Two things are necessary, however: (a) that a sharp distinction should be drawn between those components of error which are to be eliminated in the field, and those which are not to be eliminated; and that while the elimination of the one class shall be complete, no attempt shall be made to eliminate the other; (b) that the statistical process of the estimation of error shall be modified so as to take account of

the field arrangement, and so that the components of error actually eliminated in the field shall equally be eliminated in the statistical laboratory.

In reconciling thus the two *desiderata* of the *reduction of error* and of the *valid estimation* of error, it should be emphasised that no principle is in the smallest degree compromised. An experiment either admits of a valid estimate of error, or it does not; whether it does so, or not, depends not on the actual arrangement of plots, but only on the way in which that arrangement was arrived at. If the arrangement ABBAABBA was arrived at by writing down a succession of "sandwiches" ABBA, it does not admit of any estimate of certain validity, although "Student" (2) has shown reasons to think that by treating each "sandwich" as a unit, the uncertainties of the situation are much reduced. If, however, the same arrangement happened to occur subject to the conditions that each pair of strips shall contain an A and a B, but that which came first shall be decided by the toss of a coin, then a valid estimate may be obtained from the four differences in yield in the four pairs of strips. It is not now the "sandwiches" but the pairs of strips which provide independent units of information, and these units are double the number of the "sandwiches."

Moreover, if the experiment is repeated, either by replication on the same field, or at different farms scattered over the country, the arrangement must be obtained afresh by chance for each replication, so that in only a small and calculable proportion of cases will the sandwich arrangement be reproduced.

Thus validity of estimation can be guaranteed by appropriate methods of arrangement, and on the other hand there is reason to think that well-designed experiments, yielding a valid estimate of error, and therefore capable of genuine significance tests, will give actual errors as small as even the most ingenious of systematic arrangements. It is difficult to prove this assertion save by experimenting on the data provided by uniformity trials, because, in the absence of any satisfactory estimate of error, it is impossible to tell for certain how accurate, or inaccurate, such systematic arrangements really are; while the aggregate of the uniformity trial data, hitherto available, is scarcely adequate for any such test. What can be said for certain is, that experiments capable of genuine tests of significance can easily be designed to be

very much more accurate than any experiments ordinarily conducted.

A Useful Method.—The distinction between errors eliminated in the field, and the errors which are to be carefully randomized in order to provide a valid estimate of the errors which cannot be eliminated, may be made most clear by one of the most useful and flexible types of arrangement, namely, the arrangement in "randomized blocks." Let us suppose that five different varieties are to be tested, and that it is decided to give each variety seven plots, making thirty-five in all. It would be a perfectly valid experiment to divide the land into thirty-five equal portions, *in any way one pleased*, and then to assign seven portions chosen wholly at random to each treatment. In such a case, as has been stated above, no modification is introduced in the process of estimating the standard error from the results, for no portion of the field heterogeneity has been eliminated. On most land, however, we shall obtain a smaller standard error, and consequently a more valuable experiment, if we proceed otherwise. The land is divided first into seven blocks, which, for the present purpose, should be as compact as possible; each of these blocks is divided into five plots, and these are assigned in each case to the five varieties, independently, and wholly at random. If this is done, those components of soil heterogeneity which produce differences in fertility *between plots of the same block* will be completely randomized, while those components which produce differences in fertility between different blocks will be completely eliminated. In calculating an estimate of error from such an experiment, care must of course be taken to eliminate the variance due to differences between blocks, and for this purpose exact methods have been developed (1. pp. 176-232).

Most experimenters on carrying out a random assignment of plots will be shocked to find how far from equally the plots distribute themselves; three or four plots of the same variety, for instance, may fall together at the corner where four blocks meet. This feeling affords some measure of the extent to which estimates of error are vitiated by systematic regular arrangements, for, as we have seen, if the experimenter rejects the arrangement arrived at by chance as altogether "too bad," or in other ways "cooks" the arrangement to suit his preconceived ideas, he will either (and most probably) increase the standard error as estimated from the yields;

or, if his luck or his judgment is bad, he will increase the real errors while diminishing his estimate of them.

The Latin Square.—For the purpose of variety trials, and of those simple types of manurial trial in which every possible comparison is of equal importance, the problem of designing economical and effective field experiments, reduces to two main principles (*i*) the division of the experimental area into the plots as small as possible subject to the type of farm machinery used, and to adequate precautions against edge effect; (*ii*) the use of arrangements which eliminate a maximum fraction of the soil heterogeneity, and yet provide a valid estimate of the residual errors. Of these arrangements, by far the most efficient, as judged by experiments upon uniformity trial data, is that which the writer has named the Latin Square.

Systematic arrangements in a square, in which the number of rows and of columns is equal to the number of varieties, such as

```
A B C D E        A B C D E
E A B C D        D E A B C
D E A B C        B C D E A
C D E A B        E A B C D
B C D E A        C D E A B
```

have been used previously for variety trials in, for example, Ireland and Denmark; but the term "Latin Square" should not be applied to any such systematic arrangements. The problem of the Latin Square, from which the name was borrowed, as formulated by Euler, consists in the enumeration of *every possible* arrangement, subject to the conditions that each row and each column shall contain one plot of each variety. Consequently, the term Latin Square should only be applied to a process of randomization by which one is selected at random out of the total number of Latin Squares possible; or, at least, to specify the agricultural requirement more strictly, out of a number of Latin Squares in the aggregate, of which every pair of plots, not in the same row or column, belongs equally frequently to the same treatment.

The actual laboratory technique for obtaining a Latin Square of this random type, will not be of very general interest, since it differs for 5×5 and 6×6 squares, these being by far the most useful sizes. They may be obtained quite rapidly, and the Statistical Laboratory at Rothamsted is prepared to supply these, or other types of randomized arrangements, to intending experimenters; this procedure is considered the

more desirable since it is only too probable that new principles will, at their inception, be, in some detail or other, misunderstood and misapplied; a consequence for which their originator, who has made himself responsible for explaining them, cannot be held entirely free from blame.

Complex Experimentation.—Only a minority of field experiments are of the simple type, typified by variety trials, in which all possible comparisons are of equal importance. In most experiments involving manuring or cultural treatment, the comparisons involving single factors, *e.g.*, with or without phosphate, are of far higher interest and practical importance than the much more numerous possible comparisons involving several factors. This circumstance, through a process of reasoning, which can best be illustrated by a practical example, leads to the remarkable consequence that large and complex experiments have a much higher efficiency than simple ones. No aphorism is more frequently repeated in connection with field trials, than that we must ask Nature few questions, or, ideally, one question, at a time. The writer is convinced that this view is wholly mistaken. Nature, he suggests, will best respond to a logical and carefully thought out questionnaire; indeed, if we ask her a single question, she will often refuse to answer until some other topic has been discussed.

A good example of a complex experiment with winter oats is being carried out by Mr. Eden at Rothamsted this year, and is shown in the diagram.

Nitrogenous manure in the form of Sulphate (S), or Muriate (M) of ammonia, is applied as a top dressing *early*, or *late* in the season, in quantities represented by 0, 1, 2. When no manure is applied, we cannot, of course, distinguish between sulphate and chloride, or between early and late applications; nevertheless, since the general comparison 0 *versus* 1 dose is one of the important comparisons to be made, the number of plots receiving no nitrogenous manure (corresponding roughly to the so-called "control" plots of the older experiments) are made to be equal in number to those plots receiving one or two doses. This makes twelve treatments, and these are replicated in the above sketch in eight randomized blocks. Note what a "bad" distribution chance often supplies; the chloride plots are all bunched together in the middle of the first block, while they form a solid band across the top block on the right; in the bottom block on the right, too, all the early plots are on one side, and all the late plots on the other.

	2 M EARLY	2 S LATE		2 S LATE			1 S EARLY
1 S EARLY	1 M EARLY	1 M LATE	1 S LATE	2 M EARLY	2 M LATE	1 M EARLY	1 M LATE
	2 M LATE		2 S EARLY		1 S LATE		2 S EARLY
2 S EARLY	2 M EARLY		1 M LATE		2 S EARLY	2 S LATE	2 M LATE
	1 S LATE	1 S EARLY	1 M EARLY	1 M LATE			1 S LATE
2 M LATE		2 S LATE		2 M EARLY		1 M EARLY	1 S EARLY
2 S EARLY	2 M LATE	1 S EARLY	2 M EARLY	2 S LATE	2 S EARLY	2 M EARLY	
		1 M LATE		1 M EARLY	2 M LATE		1 M LATE
2 S LATE	1 M EARLY		1 S LATE			1 S EARLY	1 S LATE
2 M EARLY	1 M EARLY	2 M LATE	2 S LATE	1 S EARLY			1 S LATE
1 S LATE			1 M LATE	1 M EARLY	2 S EARLY	2 M LATE	
1 S EARLY		2 S EARLY			2 M EARLY	2 S LATE	1 M LATE

FIG. 1.—A COMPLEX EXPERIMENT WITH WINTER OATS.

The value of such large and complex experiments is that all the necessary comparisons can be made with known and with, probably, high accuracy ; any general difference between sulphate and chloride, between early and late application, or ascribable to quantity of nitrogenous manure, can be based on thirty-two comparisons, each of which is affected only by such soil heterogeneity as exists between plots in the same block. To make these three sets of comparisons only, with the same accuracy, by single question methods, would require 224 plots, against our 96 ; but in addition many other comparisons can also be made with equal accuracy, for all combinations of the factors concerned have been explored. Most important of all, the conclusions drawn from the single-factor comparisons will be given, by the variation of non-essential conditions, a very much wider inductive basis than could be obtained, by single question methods, without extensive repetitions of the experiment.

In the above instance no possible interaction of the factors is

disregarded ; in other cases it will sometimes be advantageous deliberately to sacrifice all possibility of obtaining information on some points, these being believed confidently to be unimportant, and thus to increase the accuracy attainable on questions of greater moment. The comparisons to be sacrificed will be deliberately confounded with certain elements of the soil heterogeneity, and with them eliminated. Some additional care should, however, be taken in reporting and explaining the results of such experiments.

References.—(1) R. A. Fisher : *Statistical Methods for Research Workers.* (Oliver & Boyd, Edinburgh, 1925) ; (2) " Student " : *On Testing Varieties of Cereals.* (*Biometrika*, XV, pp. 271-293, 1923) ; (3) Sir John Russell : Field Experiments : How They are Made and What They are. (*Jour. Min. Agric.*, XXXII, 1926, pp. 989-1001.)

TRIALS OF SUB-SOILING IN 1925

Contributed by the Institute of Agricultural Engineering, University of Oxford.

THE general methods of sub-soiling were detailed in an article which appeared in this JOURNAL for January, 1923, and included also the results of tests of several machines designed for this purpose. The introductory note drew attention to the confusion which existed between deep ploughing and sub-soiling proper. The two processes were not kept sufficiently distinct ; consequently the often unsatisfactory results of the former came to be erroneously attributed to the latter. Deep ploughing inverts the soil, and the soil thus brought from below to the surface may require a considerable amount of weathering before it becomes fertile. True sub-soiling aims at disturbing the lower soil without bringing it to the surface. It breaks up the hard " pan " formed, on many lands, as a result of chemical action or continuous cultivation, and allows a freer passage for water and air, without mixing with the upper fertile soil the earth which it disturbs.

Trials in Essex and Oxfordshire.—In the winter of 1922 and the spring of 1923 the Ministry, in co-operation with the East Anglian Institute of Agriculture, sub-soiled a series of plots in Essex for a five years' experiment. The conduct of these experiments was subsequently transferred to the Institute of Agricultural Engineering at Oxford, and in 1924 further plots were laid down in Oxfordshire. From the

beginning of the experiments the sub-soiled and the control plots have received identical treatment in the matter of cultivation, manure and seeds, and no further sub-soiling has been done since the plots were originally prepared.

The results of the first year's experiments, published in this JOURNAL for February, 1924, showed that on every one of the sub-soiled plots the yield was greater than on the control plots, which were ploughed only without being sub-soiled. This extra yield was always sufficient in value to repay the extra cost of sub-soiling. The detailed results for 1923 and 1924 appeared in this JOURNAL for January, 1925; they showed that in the second year after sub-soiling increased returns were still being obtained. The present note deals with the results obtained in the third year of the original experiment and some results of the second year of the experimental plots in Oxfordshire. From the results given it will be seen that each sub-soiled plot has again produced a greater yield than the plots in the same field which were not sub-soiled. While the increase is not always as marked as in previous years it is still substantial and affords sufficient evidence that the beneficial effect of sub-soiling lasts for at least three years. The results given in Table III are of interest as showing the value of sub-soiling for roots.

Though not occurring on one of the experimental fields, reference may be made to a remarkable feature which was observed on a field of London clay, sub-soiled three years ago. This bore last season a crop of clover, and the sub-soiled portions could be readily distinguished from those which had not been sub-soiled by their comparative freedom from weeds which were prevalent on the latter. On several of the experimental fields it was easy to recognise the sub-soiled portions with the eye, owing to the stronger and healthier appearance of the crop.

Tabulated Results.—The tables, with one exception (Table IV), continue the tables given in the report which appeared in this JOURNAL for January, 1925, and are numbered identically. Tables I to V give results from fields in Essex sub-soiled in the winter of 1922-23; Table VI refers to a field in Oxfordshire sub-soiled in the spring of 1924. It is unfortunate that on the stone brash plots in Oxfordshire there were again no results. The field could not be got ready for proper sowing and the whole crop was a failure.

As regards Table IV it should be explained that in the winter of 1922-23 two fields on boulder clay, in different parts of Essex, were sub-soiled for the purposes of this experiment. The record of one of these was given in Table IV of the previous report, but could not be included in the present report, owing to the 1925 crop (clover) being too patchy to allow of any useful results being collected. The other field suffered a similar failure in 1923 with a roughly sown crop of barley which was mostly taken by birds. Its record was consequently not included in the previous report. It is given, for the past two years, in the present Table IV as affording some evidence for the third year after sub-soiling on boulder clay. The decreased value of the wheat on the 7-inch sub-soiled plot will be observed. It is balanced by the increase of the barley, and the average of the two results gives a satisfactory figure.

The value of the crops for the past season has been based on the weekly market reports. For the two preceding seasons they were, with one exception, based on the actual price obtained when the produce was sold. As was explained in the 1924 report, money values, while constituting a convenient method of comparison, cannot be taken as an exact criterion. Not only do these values vary from time to time, but they differ for different crops. At the same time, the difference between the value on sub-soiled and unsub-soiled plots, accumulated over a period of years and balanced against the cost of sub-soiling, offers a ready means of estimating the value of the process.

The following tables all give results per acre. In all cases both the control and the sub-soiled plots were ploughed to a depth of five inches.

TABLE I

SAND AND GRAVEL (FIELD I)

Depth of sub-soiling	Crop	Yield per acre		Market price value per acre of extra yield
		Grain	Straw	
		cwt.	cwt.	£ s. d.
Not s.s.	Linseed	9·7	14·2	—
5 ins. ..	,, ...	12·3	19·2	2 16 11
7 ins. ..	,, ...	12·8	19·0	3 6 10
9 ins. ..	,, ...	13·1	17·4	3 11 9

Previous Cropping: 1923, Potatoes; 1924, Spring Barley.

TABLE II

SAND AND GRAVEL (FIELD II)

Depth of sub-soiling	Crop	Yield per acre		Market price value per acre of extra yield
		Peas	Straw	
		cwt.	cwt.	£ s. d.
Not s.s. ..	Peas	23·5	23·5	—
5 ins. ..	,, ...	27 3	27·3	6 3 3
7 ins. ..	,, ...	23 8	24·8	0 11 0
9 ins. ..	,, ...	29·3	27·6	9 6 1

Previous Cropping: 1923, Potatoes, 1924, Winter Barley.

TABLE III

BRICK EARTH

Depth of sub-soiling	Crop	Yield per acre	Market price value per acre of extra yield
		tons	£ s. d.
Not s.s. ..	Kohl-rabi ..	14 3	—
5 ins	,, .	19 3 .. .	6 5 4
7 ins. .	,, .	16 1	2 4 2
Not s.s. ..	Mangolds .	25·3	-
7 ins .	,, ..	27·8 .. .	2 10 9
9 ins. ..	,, ..	32 7 .. .	7 8 6

Previous Cropping 1923, Barley ; 1924, Oats.

TABLE IV

BOULDER CLAY

Depth of sub-soiling	Year and crop	Yield per acre		Market price value per acre of extra yield
		Grain	Straw	
		cwt.	cwt	£ s. d.
Not s.s. ..	1924 Beans .	19	18	—
5 ins. ..	,, ..	25·1	23	3 17 0
7 ins. ..	,, ..	23·5	21·3	2 16 5
Not s s. ..	1925 Wheat	14·2	24·9	—
5 ins. ..	,, ..	15·7	25·6	1 0 9
7 ins. ..	,, ..	14·6	21·6	0 1 8 (decreased value)
Not s.s. ..	Barley ..	8·9	9·5	—
7 ins. ..	,, ..	12·3	12·4	2 0 6

Previous Cropping: 1923, Barley (failed).

TABLE V
LONDON CLAY

Depth of sub-soiling	Crop	Yield per acre		Market price value per acre of extra yield
		Grain	Straw	
		cwt.	cwt.	£ s. d.
Not s.s. ..	Wheat ..	17·4	27·3	—
7 ins. .	" ..	22·8	34·0	4 8 0

Previous Cropping: 1923, Wheat; 1924, Peas.

TABLE VI
OXFORD CLAY

Depth of sub-soiling	Crop	Yield per acre		Market price value per acre of extra yield
		Grain	Straw	
		cwt.	cwt.	£ s. d.
Not s.s. ..	Oats	22·3	20 3	—
5 ins. ..	" .. .	27 6	25 2	3 3 4
7 ins. ..	" .. .	26·6	25·8	2 16 6

Previous Cropping: 1924, Tares and Oats (Ensilage); Sub-soiled Spring, 1924.

BACILLARY WHITE DIARRHŒA OF CHICKS

T. M. DOYLE, F.R.C.V.S.,
Ministry of Agriculture and Fisheries.

Introduction.—Bacillary white diarrhœa is an acute septicæmic disease of young chicks caused by the *Bacillus pullorum*. The infection also occurs in adult fowls in a chronic form which rarely ends fatally. The fowl is the only species susceptible to natural infection. There is no record of the introduction of the disease into Great Britain, but it has probably existed here for a very long time. The great expansion of poultry farming during recent years, and more particularly the increased employment of artificial methods of incubation and the large unit system, have brought it into prominence.

Bacillary white diarrhœa is essentially a disease of artificial incubation. It may also occur where only natural methods of hatching are employed, but in such cases it rarely causes

trouble and tends to disappear. Although chicks hatched under hens are just as susceptible as those artificially incubated, the mortality is smaller and there are fewer carriers amongst the survivors. This is partly due to the dark, warm atmosphere of the brooder which favours the survival of the causal parasite, while under natural conditions light and temperature have an inhibitory effect, tending to destroy it.

As hen-hatched chicks also are continually on the move, infection is disseminated over a wide area, and the same favourable conditions for contamination do not occur as in a crowded brooder. Furthermore, an incubator holds a large number of eggs, and consequently the risk that some of these may have come from a carrier bird is relatively greater.

Diagnosis.—When a high mortality occurs in a brood within a few days of hatching, and the majority show symptoms of diarrhœa which cannot be attributed to faulty management, bacteriological examination should invariably be carried out. A bacteriological examination is the only reliable method of ascertaining the presence of the disease. No confidence can be placed in a diagnosis based on the naked-eye appearances found at post-mortem examination. Adult fowls, that harbour the organism in the system, can be detected by the agglutination test or, if killed, by bacteriological examination of the organs. The disease is to be differentiated from dietary troubles, coccidiosis, aspergillosis, and avian typhoid.

Source of Infection.—Infection may occur in various ways. The principal means of dissemination is through infected eggs. It has been conclusively proved that a large number of chicks which survive the disease retain the causal organism in their systems and later transmit it through the eggs. Usually, only a small number are born infected, and these serve to infect others in the incubator or in the brooder. Chicks are particularly susceptible during the first three or four days of life. This susceptibility is greatest up to about the thirty-sixth hour, and then gradually diminishes, until by the fourth or fifth day they are practically immune to acute infection.

Recent inquiry has shown that carrier birds are able to liberate the *Bacillus pullorum* in the fæces as well as through the eggs, and are a continual source of danger. The runs become contaminated, and chicks pick up the infection, or it may be carried to them by indirect means as, for example, on the hands or boots of attendants. Brooders and incubators which have recently held diseased chicks are another fruitful source of infection.

Mortality.—Bacillary white diarrhœa is the most fatal and widespread disease to which young chicks in this country are exposed. The death rate varies from 30 to 90 per cent., with an average mortality of about 75 per cent.

Symptoms.—In general it may be stated that the symptoms are not characteristic. They resemble those of other intestinal diseases of young chicks, and are of little assistance in making a diagnosis. The history of an outbreak is, however, of some value. When a heavy mortailty occurs in a hatch during the first four or five days of life, and when the majority have diarrhœa, provided there has been no mismanagement, the possibility of the existence of bacillary white diarrhœa must be seriously considered. The disease usually appears within two or three days after the chicks are hatched, and spreads rapidly through the brood. The period of incubation is four to ten days.

The affected chick is drowsy in appearance and sways backwards and forwards when in a standing position. The appetite is diminished or in abeyance. The most characteristic symptom is the presence of a white or yellowish diarrhœa; but this may be absent in a small number of chicks. In acute cases the chick may be found dead without having shown any previous illness. In chronic cases lasting one to three weeks, emaciation is marked and the gait uncertain. The chicks that survive acquire the appearance of having a short back and a large abdomen.

Post-mortem Appearances.—The naked-eye appearances found on post-mortem examination are not sufficiently characteristic or constant to enable a definite diagnosis to be made. If the attack has been acute there will not have been sufficient time for changes to have occurred. The yolk is usually unabsorbed: this may, however, be due to other causes, such as weak constitution or faulty incubation.

The light yellow colour of the liver which is frequently stated to be a lesion of the disease is merely the normal appearance during the first few days of life; it gradually changes to a dark brown. Congestion and necrotic nodules in the lungs are the most characteristic lesions found, and occur in about 40 per cent. of cases.

Pneumonia with purulent foci is frequently encountered in incubator hatched chicks, and such cases may easily be mistaken for the lesions found in the specific pneumonia of bacillary white diarrhœa.

Infected Eggs.—Recent inquiry has shown that the number of infected eggs laid by carrier birds varies with the individual; sometimes they are of rare occurrence, while in other cases

as many as 18 per cent. may be infected. This explains the cases, occasionally met with, where some hatches are healthy while others are diseased, although the eggs are from the same stock. The yolk is the only part of the egg that contains the causal organism.

The Agglutination Test.—This test is very delicate and reliable, and of indisputable value for the detection of carrier birds, but, like other serological methods of diagnosis, is not infallible. When properly carried out and correctly interpreted, the percentage of error is small and does not diminish, to any appreciable extent, its practical value.

The test is based on the presence of substances known as agglutinins in the blood serum of infected animals. There are no agglutinins for the *Bacillus pulloram* in the serum of healthy fowls, which, therefore, never give a positive reaction. In the diagnosis of other diseases a positive reaction is generally regarded as signifying either past or present infection. In bacillary white diarrhœa a positive reaction would appear to indicate present infection ; this conclusion is based on the results obtained from the bacteriological examination of a large number of reactors.

A point of practical importance is that reacting birds always have infection of the ovary ; other organs may also be infected. A certain interval must elapse between the bird becoming infected and giving a reaction to the test. In artificially infected birds this period is about six days. It is probably somewhat longer under natural conditions. For this reason it is advisable to retest the flock after an interval of one month. It is well known that one agglutination test is not usually sufficient to enable infection to be completely eliminated from a farm. The first test picks out most of the affected birds, but a second, or even a third test generally results in finding one or two further cases. In exceptional cases, one test has been successful, and a high percentage of healthy chicks has been hatched from the non-reacting stock.

Although the test has proved to be extremely reliable, it has not fulfilled its early promise of providing a speedy method of eradicating the disease from infected flocks. It is too expensive and laborious to be solely relied upon, and should be regarded only as a temporary measure to allow of the carrying on of breeding operations until such time as the infected flock can be replaced by healthy young birds.

In view of the large amount of blood testing which is being carried out at present, it is advisable to direct attention to

the limitations of this method, otherwise it may be wrongly employed, its value exaggerated, and public confidence in it destroyed.

(1) The test should be applied only to infected flocks.
(2) Stock birds only should be tested.
(3) One test of an infected flock is no guarantee of the complete elimination of the disease.
(4) When a whole flock, which has no previous history of bacillary white diarrhœa, passes one agglutionation test, there are reasonable grounds for presuming it is free from the disease.
(5) To be certain within reason that all infection has been eliminated from a flock, all the birds must at the same time give negative reactions to two successive tests. This is necessary only in the case of owners who wish to guarantee eggs or chicks free from the disease.
(6) An owner is justified in guaranteeing the eggs or chicks of tested stock free of bacillary white diarrhœa only when Clause (4) or (5) has been fulfilled.

The Carrier Fowl.—The carrier fowl is one in which the *Bacillus pullorum* is localised in one or more of the internal organs. The organs infected in order of frequency are the ovary or testicle, spleen, gall-bladder wall, kidney, and liver. The heart blood, bone marrow, and lung do not appear to be infected in the adult.

The majority of carriers acquire infection when in the chick stage. They show no symptoms and are usually in excellent condition. A small number of carrier birds overcome the infection and make a complete recovery ; the extent to which this occurs is too small to be of practical importance. Occasionally a first test of lightly infected birds, particularly cocks, is positive, whereas a second test made after a short interval may be negative. If further tests are carried out it is usually found that positive reactions will again occur. A positive reaction should always be accepted as indicating infection, and the bird should be removed from the flock.

A large number of carriers show marked pathological changes in the ovary ; the appearance presented by the diseased organ is quite characteristic (see Fig. 1). The ova are hard, shrunken, and angular, and the natural yellow colour is changed to a dark brown or greenish tint. On section, the ova are of a tough cheesy consistency, and have a yellowish red or greenish tinge.

It has recently been shown that, as the result of the changes in the ovary, the egg-laying powers of " carriers " are very seriously impaired ; the majority of these birds probably are kept at a loss. The carrier hen, therefore, is unprofitable as well as a source of danger.

It is frequently stated that all chicks are carriers of the causal organism of bacillary white diarrhœa, and that as the result of adverse conditions, such as weak constitutions, inclement weather, or dietetic errors, the disease makes its appearance. No evidence has been produced to substantiate this speculation, and in some cases, at least, it is brought forward merely to excuse the sale of diseased chicks. The bacteriological examination of a large number of known healthy chicks of varying ages, and from many hatches, has failed to reveal the presence of *Bacillus pullorum*. It may be concluded that this organism is not a normal inhabitant of the healthy chick.

The Cock Bird.—It is not known definitely if the cock bird plays any part in the spread of the disease. Young chicks of both sexes are equally susceptible, but as development proceeds the majority of cocks appear to overcome infection and a small number only become carriers. It is improbable that the cock bird is a transmitting agent of first importance, but it is possible that it may act mechanically in transferring infection from a diseased to a healthy hen. It is probable that the fæces of infected cocks contain the *Bacillus pullorum* in a similar manner to those of carrier hens. It would be wrong, therefore, to disregard the cock as a possible source of infection and, until more knowledge has been acquired, it is advisable to dispose of reactors.

Treatment.—Attempts to cure affected chicks are futile and inadvisable. Despite the many so-called "cures" on the market, there is no known method of treatment which is of the slightest value. Furthermore, the fact that many chicks which recover harbour the causal agent, and are a potential source of future outbreaks, is a strong argument against the policy of treatment.

Vaccination.—Vaccines do not confer immediate protection when introduced into the body; there is a period of four to five days after inoculation, during which susceptibility is actually increased. Owing to the rapid development of bacillary white diarrhœa, vaccination is of no value. It confers no protection during the susceptible period, and the danger of acute infection has passed before immunity is acquired.

Control and Eradication.—In spite of the widespread distribution of the disease, its complete eradication from infected flocks presents no great difficulty, and can be achieved in a relatively short time.

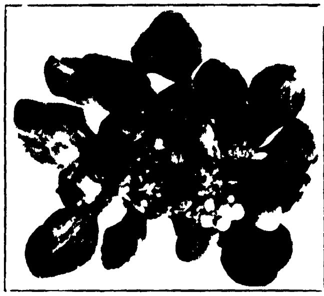

FIG. 1. Ovary infected with *B. pullorum*

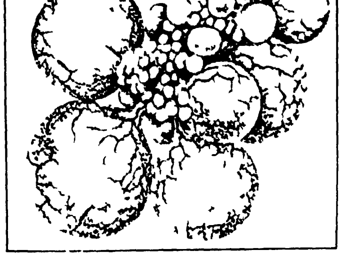

FIG. 2. Normal Ovary. (Rathgar, Kirkpatrick and Jones.)

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There are certain factors which are of great assistance in the control of poultry diseases. These are :—

(*a*) The relatively small value of the individual fowl permits its destruction when diseased without involving the owner in any serious loss. It is a sound policy, at the first appearance of a contagious disease, to destroy the affected birds and limit the spread of infection.

(*b*) The short average life of the fowl facilitates the replacement of a diseased flock by healthy young birds in a brief space of time.

These two factors are particularly valuable in controlling bacillary white diarrhœa.

The measures for dealing with outbreaks may be divided into two parts :—

(1) The elimination of carrier birds by the agglutination test.

(2) The building up of a healthy flock.

As soon as the disease has been diagnosed by a bacteriological examination, the stock birds should be tested, and reactors immediately removed from the flock. It is most important to move those birds which have passed the test on to clean ground to prevent further cases arising from the infected runs. The contaminated ground should be heavily dressed with ground quick lime* and left vacant for at least one month.

As one test is unlikely to eliminate all carriers, it is advisable to divide the flock into groups and to put a distinguishing mark on the eggs from each group. The size of a group will depend on the egg capacity of the incubators employed. In a general way it should be so arranged that the eggs from one or two groups will be sufficient to fill one incubator within reasonable time. If the eggs from the flock are mixed indiscriminately in the incubators, it will be necessary, if the disease reappears, to retest all the birds.

With the group system it will be necessary to retest only the groups which provided the eggs for the particular incubator in which the disease has occurred. The chicks hatched out in different incubators should not be mixed before they are ten days old, and then only if there has been no abnormal loss.

The Building up of a Healthy Flock.—Chicks which have survived an outbreak should not in any circumstances be used for breeding purposes. Recent inquiry has shown that a large number are carriers and they will be the means of

* See Leaflet No. 170, Ministry of Agriculture and Fisheries.

starting fresh outbreaks. The practice of breeding from them is responsible in a large measure for the present widespread distribution of the disease and for the lack of success of efforts at eradication.

It is not a sound policy to employ the agglutination test for the elimination of carriers from amongst the chickens which survive an outbreak. The flock infection is usually so heavy that three or more tests are necessary to ensure success. The value of the birds is not sufficient to pay for the tests and for the time and labour expended in obtaining the blood.

If the number of chicks which survive an outbreak is small they should be destroyed. If, however, the number is considerable, to destroy them might cause considerable financial loss; in such circumstances they should be isolated and fattened for table purposes.

Healthy chicks and those which have survived an outbreak should not be run together as, apart from the risk of the healthy contracting the infection from the contaminated ground, it is difficult or impossible when the time arrives for the selection of birds for breeding stock to know whether they came from diseased or healthy broods. In such circumstances some owners have recourse to the agglutination test; an expensive and unsatisfactory method of dealing with a problem which the exercise of a little foresight would have avoided.

Clear or infertile eggs should not be fed to chicks, as they may be infected and be the means of starting an outbreak.

The agglutination test can also be employed for the protection of healthy flocks, and, in view of the prevalence of the disease, new birds should be purchased subject to passing it. The cost is insignificant compared with the valuable protection it confers.

Summary.—The measures, step by step, for dealing with an outbreak of bacillary white diarrhœa, are as follows:—

(1) When abnormal losses occur in a brood, without any apparent cause, a bacteriological examination should invariably be carried out.

(2) If bacillary white diarrhœa is diagnosed the adult stock birds should be submitted to the agglutination test.

(3) Reactors should be removed from the flock and disposed of for table purposes.

(4) The healthy birds should be moved to fresh ground.

(5) The infected runs should be given a heavy dressing with

ground quick lime and left vacant for at least one month. Incubators, brooders, and houses should be thoroughly sprayed with a reliable disinfectant.

(6) Divide the flock into groups and put a distinguishing mark on the eggs from each group. Each incubator should be reserved for the eggs from one or several groups.

(7) Chicks which survive an outbreak should either be destroyed or isolated and fattened for the table.

(8) The agglutination test should not be employed for the elimination of carriers from amongst the chickens which survive an outbreak.

(9) Chickens from healthy broods only should be reserved for breeding purposes.

Veterinary Tests for Poultry Diseases.—The Ministry carries out post-mortem examinations, agglutination tests for the detection of adult "carriers" of bacillary white diarrhœa, and other bacteriological work in connection with poultry at its veterinary laboratory.

It is open to poultry-keepers whose birds are dying or who have other evidence of the existence of disease in their flocks to avail themselves of the facilities provided for diagnosis.

Fees.—The charge for an ordinary post-mortem examination is 3s. a bird. In the case of birds submitted for post-mortem or other examination from egg-laying trials, a reduced fee of 2s. per bird is charged.

In cases where flocks are suspected of being infected with Bacillary White Diarrhœa an inclusive fee of 10s. is charged for a diagnosis. This fee covers whatever number of laboratory tests are required to establish or otherwise the existence of the disease. In cases, therefore, where chicks have died in considerable numbers, several specimen chicks should be sent for examination as soon as possible after death, in order to provide sufficient material for the laboratory tests. If further material is required the Laboratory will ask for it, but will make no further charge beyond the prescribed fee of 10s.

In flocks where Bacillary White Diarrhœa has been found to exist, samples of blood of adult birds will be tested at the laboratory at an additional fee of 1s. per bird up to forty, and at the rate of 6d. for every bird over that number.

Sterile tubes for the collection of blood samples will be supplied to applicants by the laboratory.

Technique of Bleeding Fowls.—Fowls should be fasted for twenty-four hours before bleeding. Raise the wing from the body and disinfect the under surface. Plucking the feathers

from the under surface assists the operation. Lay the fowl on its side and hold down with the left forearm. Grasp and extend the upper wing backwards with the left hand.

With a sharp pointed knife make a small incision in the vein where it passes over the surface of the elbow. Allow the blood to collect in the hollow formed by the elbow and wing membrane, and scoop up the blood with the tube until a quarter full. Usually no effort is required to stop the flow of blood, but it is well to apply momentary pressure over the cut.

Label the tube with the number of the bird as it is impossible and unnecessary to put name on each tube. Set aside in a cool place and allow to clot. Care should be taken not to agitate the sample while the clot is forming.

Mark the packet conspicuously, "FRAGILE, WITH CARE, PATHOLOGICAL SPECIMEN," and dispatch by letter post pre-paid (see page 24 P.O. Guide), to :—

Chief Veterinary Officer of the
Ministry of Agriculture and Fisheries Laboratory,
New Haw, Weybridge.

A covering letter should be sent at the same time giving the name and address of the owner of the birds and date of dispatch of samples.

MILK PRODUCTION AND MARKETING

K. H. BOND

THE mind of every producer of milk is occupied at the moment with the question of milk prices for the coming contract year. The time is, therefore, opportune for a short survey of the position of the milk-producing industry in the matter of bargaining.

Bargaining is but a part of marketing. The whole is greater than the part, and a survey to be complete must examine all aspects of the question. Marketing—one uses the word in its widest sense—embraces organisation for sales, maintenance of quality, control of output, the manufacture of surpluses and by-products, and the grading of produce. Each of these factors has a more or less important bearing on milk production, the fundamental object in each instance being to exploit to the producer's advantage the operation of the economic law of supply and demand. Milk recording, breeding for milk,

scientific rationing and other progressive means of improving the lot of milk producers, are at the moment much less important to milk producers than is marketing in its widest sense. To interpret marketing in the narrow sense of sales organisation and to rely on the perfecting of that alone as the solution of the industry's present problem—the securing of adequate return—is unsound policy, because it is an incomplete policy.

The law of supply and demand is inexorable. Collective bargaining must be accompanied by an organised endeavour to regulate the supply to the demand, and to stimulate demand to the measure of the supply. The latter, though an important desideratum, is inevitably slow to take effect, by whatever means it is attempted. The regulation of supplies, even if it calls for great organisation, is the more potent factor in maintaining the price level.

While this country imports from abroad dairy produce in the form of dried, condensed and evaporated milk, cheese and butter to the equivalent of 1,500 million gallons of milk per annum, it cannot be said that it suffers from an over production of milk. There is no case for general restriction of milk production. There is, however, serious over-stocking of the *liquid* milk market, almost throughout the year, owing to recent great increase in milk production and, though in less degree, to higher average yields per cow. The disparity between the price realised on yearly contracts for liquid milk to be sold as such to consumers, and the return obtained when milk is manufactured into butter or cheese and the by-products of that manufacture are fed to stock, together with the increased facilities for transit due to motor transport, have led to a scramble for the liquid milk market and a general disregard of manufacturing processes by the producer.

The burden of the utilisation of surpluses in the liquid milk trade now rests on the shoulders of the distributors, who guard themselves by a surplus clause in the contracts. This is a bad policy for the producer, since the chance to manipulate the law of supply and demand to his advantage is lost.

Fearing serious surpluses of milk, with which he may be unable to deal, the buyer has covered himself with a clause that he may refuse supplies on the contract at a penalty of 2d. per gallon for every gallon refused. During the past year he has been able on occasion to refuse contract supplies, forfeit the

2d. per gallon, and still buy in lieu supplies on the open milk market at 5d. per gallon less than the contract price, with a net gain to himself of 3d. per gallon. This is greatly to the disadvantage of the unprepared contracting farmer, who suddenly finds that he has to keep all the milk produced at home and do the best he can with it. The danger of handing over to the buyer the responsibility of disposing of surpluses is only too well illustrated by such occurrences.

East Sussex and Essex provide examples of definite, organised attempts on the part of the producers to shoulder the responsibility for the utilisation of surplus milk by the establishment of co-operative cheese factories. These examples will need to be followed throughout the milk-producing districts of the country. In the districts where they are established, competition from other counties not so prepared may render such isolated attempts ineffectual as bargaining factors.

The commercial success of such undertakings is dependent on a return being secured which will cover the cost per gallon of the milk utilised, and while this can be achieved in the summer months, the higher cost of milk production makes it impossible in the winter months. In winter the impossibility of the producer manufacturing his surplus into dairy products at a remunerative price means that surpluses during those months are disastrous to the producer. The position can only be met by restriction of winter milk supplies.

Winter surpluses are a comparatively new feature in the industry. At the time of the publication of the Linlithgow Report (1923) they were not sufficient to constitute a serious problem ; indeed, the tendency even so late as 1923 was for supplies to be short in the winter months.

A winter milk price much greater than the summer price, larger average yields from autumn calvers, and low prices in relation to cost of production in August and September, have especially tempted those coming fresh into milk production, to produce winter milk ; the fortnightly milk cheque from which to pay wages and regular outgoings is a feature of economic importance on milk-producing farms. A surplus in the liquid milk market in winter is a serious embarrassment to the whole industry ; some restriction to bring production in nearer relation to the demand in winter is urgent. This can scarcely be effected voluntarily, and the acceptance of a lower price for the winter months, which would of itself have a slight tendency to discourage winter milk production, would

require a corresponding increase in summer milk prices to maintain the present level of returns.

If such terms were made there would be a serious danger of surplus milk competing with contract milk in summer, with a possible break in prices. The producing industry must be in a position to withhold the surplus milk from the market by manufacturing it during the summer months. It is manifest that producers should, by its own organisation, shoulder the responsibility of utilising surpluses in the liquid milk market, in order to strengthen the hands of those whose responsibility it is to drive the bargain.

The Linlithgow Report made strong recommendations in this connection, and clearly laid down the lines for sound co-operative enterprise in the manufacture of milk products. The marketing of such products in itself constitutes a problem second only to that of organisation for its manufacture, but here the problem is a different one from that of milk marketing. It is rather a question of quality and grading than of regulation of supply and demand. The governing factor in the dairy produce market is the price of imported cheese and butter, but high-class home produce commands a higher price than that imported.

Competition from abroad can only be met by quality. Though fresh Merchandise Marks Legislation might aim at preventing imported produce from being passed off as home-produced, this in itself is not sufficient, but calls for the grading of home produce in order that it shall establish definitely its superiority and uniformity. The use of a trade brand and mark, by associations of makers of the different types of cheeses manufactured in this country, for cheese of an assured quality, would not only lay down the standard of quality of each type of cheese—at present an unknown quantity—but would greatly enhance the reputation of home dairy produce. A higher price would be secured for a product of unvarying good quality.

The manufacture of milk surplus to the liquid milk trade and the marketing of the product, are wide enough subjects, but they do not exhaust the aspects of the relation of marketing to milk production. They deal with but one side of it, the regulation of supply.

The stimulation of demand, slow though it may conceivably be, must nevertheless not be ignored if the fullest benefits are to be derived from organised marketing, of which it is an integral part.

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In the forefront of those considerations affecting demand one naturally places the tendency of a lower retail price to induce greater consumption, but the limitations of the price factor are two-fold. In the first place, milk consumption is a matter of national habit, and as with bread, is much less affected by slight rise and fall in price per unit of distribution than in the case of more casual food commodities. In the City of Peterborough, though the ruling price is 1d. per quart less throughout the year than the general retail price of 7d. per quart in winter and 6d. in summer, the consumption per head of milk is not greater. The national milk-drinking habit is influenced by the general appreciation of milk as a food, the attractiveness or otherwise of its presentation to the public, and its quality. The appreciation of it as a food is a matter of education: it is too widely regarded as a mere adjunct to beverages and dishes rather than as a food in itself, which can replace other articles of diet. With this outlook is closely linked up the consideration of the quality in point of wholesomeness. This is strikingly illustrated by the fact that those who buy "graded milk" consume a greater quantity of milk per head than those who buy ordinary milk.

In recognising that quality has a direct bearing on consumption, it may be observed that the tendency of legislation to demand greater care in the production and handling of milk, even if it resulted in slightly decreased production, will tend, ultimately, to stimulate demand to the advantage of the producer, and will make easier the task of those who by publicity and by education strive to increase the appreciation of milk as a food. The presentation of milk to the consumer in bottles has a psychological effect towards the same end. If a commodity is treated with such consideration by the distributor its value is more apparent than if it is sold loose by can and dipper. The effect of packing on consumption is great, as is clearly shown by the fact that there is a ready sale for "portion cheeses" of good quality wrapped in silver paper and labelled, at 2s. 6d. per lb., as compared with bulk cheese at 1s. 8d.

Apart from the greater or less reaction of price on consumption one must consider that improvements in production and distribution necessarily reflect on the price to be charged. A lowering of the retail price would leave an insufficient margin of profit for both producer and retailer to conform to the requirements of the day; in fact the industry looks rather to the maintenance of high quality to stimulate demand than to a lower retail price.

The conclusion one is forced to on surveying the position is that there is a tendency for the producer to become a mere appendage to the milk distributive trade, in so far as the latter undertakes to dispose of surplus milk and to rectify unhygienic production by pasteurisation—a tendency which must be resisted by more complete organisation for the independence of the industry of milk production. What does that independence involve? The concentration of population in the large towns and dense industrial districts has made milk distribution a business apart. To usurp its functions even temporarily is too great a task for the producer. Rather should organisation be devoted to supplying the distributor with his needs for distribution only and the manufacturer with his needs for milk products, and to retaining the right to deal with what surpluses remain by efficient co-operative enterprise.

THE CONTROL OF THE NARCISSUS EELWORM

GORDON W. GIBSON, F.L.S.,

Isles of Scilly Experimental Station.

Introduction.—The rapid spread of the Narcissus eelworm in recent years is attributable mainly to the ease with which infested bulbs can be transported from one district to another in the ordinary course of commerce. In consequence, the progressive grower, who is anxious to plant new varieties and buys bulbs freely from many sources, either in this country or abroad, is often the first in a locality to suffer from this most devastating of all narcissus pests; and, in any event, he runs a constant risk unless reasonable precautions are taken.

Symptoms of Eelworm Attack.—Many excellent descriptions of the characteristic distortions caused by eelworm injury are available, and it is not proposed here to discuss the external signs of infestation in the different varieties of narcissus. There is considerable variation, however, in the response of the plant to the attacks of this nematode. Where eelworm is suspected, it is well to obtain expert advice as soon as possible, so that, on infection being confirmed, measures may be taken to localise the outbreak. It is important to note, also, that where the numbers of eelworm present are very small, the plant will not be distorted and may flower satisfactorily, without showing any signs of infestation.

Natural Spread of Eelworm.—The conditions which influence the severity of attack and the natural dissemination of this pest are but little understood. There is some evidence to show, however, that a high water content in the soil is favourable to a rapid spread of the nematode from the various centres of infection in the field. Where infested bulbs have been boxed and are grown under glass, the destruction of the bulb may be very rapid, as injured tissue is soon invaded by fungi and bacteria, which increase rapidly under the conditions maintained in a glasshouse. The true parasitic eelworm is very sensitive to changes in the cell sap, and the narcissus race of the stem eelworm (*Tylenchus dipsaci*) is no exception. Soon after other organisms are present, the eelworm are obliged to leave or die, and, where the decay of narcissus bulbs is very rapid, the presence of other organisms is generally indicated, although eelworm is likely to be the primary cause of the diseased state.

Soil Treatment.—It is hoped that some efficient and not too costly means of killing nematodes in the soil may be available eventually, but at present no efficient practical field method of treating infested land has been discovered. That the particular biologic race of *Tylenchus dipsaci* which infests narcissus may be starved out of land, by removing all bulbs for a period of years, is recognised. Any practical grower knows, however, how difficult it is to remove every bulb from a field, and only when all bulbs have been removed can the starving period be regarded as having started.

Precautions against Introducing or Spreading Infection.—To reduce to a minimum the risk of introducing the narcissus eelworm through the importation of fresh stocks, purchasers are strongly advised to plant only those bulbs which are certified to have been immersed in water retained at a temperature of 110° F. for three hours; and such precaution is most desirable whether the bulbs are bought in this country, Holland or elsewhere, and whether the consignment is accompanied by a health certificate or not. This hot-water treatment, described in more detail later, is the recognised remedy for eelworm-infested stock. In practically all cases, no injury will result from it if the bulb has been properly ripened and is in a dormant state, and the cost of treatment is infinitesimal compared with the loss which may ensue if the pest is introduced.

One other control measure, which every grower can adopt, is to plant all newly-acquired stocks in a sort of quarantine area. These bulbs can be treated apart from the others and should be allowed to remain for two complete growing seasons. If bulbs lightly infested by eelworm have been inadvertently acquired, there should be little difficulty in discerning them during the second season and the grower can act accordingly. If, after the second season, the bulbs still appear healthy there will be little danger of introducing the pest by planting-out on the farm.

Where, in spite of precautions, a grower finds his stock of bulbs infested, the only safe course for him to pursue is to subject all the bulbs lifted to the hot-water treatment, subsequently planting them in land which has not carried a diseased stock for several years. By this means the loss occasioned may soon be reduced to the cost of treating the bulbs. Unless some such policy be adopted, a small grower will soon find that he has no land free from eelworm in which he can plant his treated bulbs, and his chances of getting free from the worst enemy of the narcissus farm will be enormously diminished. Where patches of eelworm-infested plants are known to exist, horse cultivation over bulbs should be avoided as likely to spread the disease.

In the present state of knowledge of this pest, hay made from grass containing narcissus foliage should be used with care. The capacity of the eelworm to sustain desiccation is well known, and the presence of eelworm and eggs in dried leaves from an infested plant easily demonstrable. It is, therefore, conceivable that the pest might be carried in this way unless the material is thoroughly heated in the manure heap.

Hot Water Treatment.—Many growers are still doubtful about the value of the hot-water treatment of narcissus bulbs and desire definite evidence of the results obtained by it before submitting any of their valuable stocks to what might appear a drastic method of control. It may therefore be of value to give a brief description of the plant used for this treatment at the Bulb Treating Station, St. Mary's, Isles of Scilly, with detailed observations on each batch of bulbs treated during the 1924 season, set out in such a way that readers may draw their own conclusions.

The apparatus consists of two cylindrical tanks, 5 ft. by 4 ft., which are heated from the bottom by special coils. The steam for this purpose is provided by a boiler and led through

a reducing valve, the quantity of steam entering the coils being regulated by screw-down stop valves. Into these tanks, metal containers, capable of holding 7 to 8 cwt. of bulbs, are lowered. The bulbs are separated in the containers into several layers by the use of wire mesh trays, so that there may be water spaces between the respective layers of bulbs. Precautions are taken to prevent hot spots in the tank, and, provided the steam entering the coils is carefully controlled, the apparatus has proved satisfactory in practice.

Temperature in Tank and Bulb.—As might be expected, slight variations in temperature occur in different parts of the tank. These variations are recorded by placing maximum thermometers in various positions in the containers, and by taking the internal temperatures within the bulbs. The changes in temperature from time to time are small, and need not be of sufficient duration in any one place to be important. It has been found that the conduction of the heat from the water through the scales to the centre of the bulb, with a bulb of normal size, takes 35 to 40 minutes. Temperatures slightly in excess of 110° F. do no harm if of short duration, as they do not actually reach the growing point of the bulb, though every effort should be made to keep the temperature as constant as possible.

Duration of Treatment.—It should be carefully noted that the three hours of treatment commences from the time when the temperature in the tank is constant at 110° F., and not from the time when the container is lowered into the tank. When a large quantity of bulbs in a metal container is placed in the tank, nearly half an hour may elapse before the required temperature is obtained, so that to reckon the three hours from the time of first immersion would, in practice, reduce the period of actual treatment to about two and a half hours.

It is doubtful whether the three-hour period can be shortened even when small bulbs are to be treated. In 1923, some rather small Golden Spur bulbs were immersed for two hours at 110° F., but complete control of the eelworm was not obtained. So far as field observations in 1924 were concerned, this particular stock appeared perfectly healthy. Last year, however, a few plants came under suspicion at flowering time, and the presence of eelworm was confirmed by microscopic examination of the plant tissues.

Drying Off and After Care.—Close comparison during the growing season, between the growth and flowering of the

Fig. 1. Bulbs treated by Hot Water in 1924 showing complete control of the Eelworm during growing season 1926

Fig. 2. Bulbs during the first season (1926) after Hot Water treatment in 1925

Photo.] [*Gordon H. Gibson, F.L.S.*

FIG. 3.—Bulb Treating Plant, Scilly Experimental Station.

samples and of the bulk of treated bulbs planted by the grower, showed that better results were being obtained in the sample. As these samples, on which observations are here recorded in tabular form, were taken haphazard when the treated bulbs were tipped into the farmer's cart, it was assumed that some variation in the drying process must be responsible for the difference.

The drying-off given to the samples was very simple. The bulbs were placed in small bags, numbered for identification, and left until planting time, the farmer being advised to cool and dry the bulbs in the packing shed, but this recommendation was not usually followed. On account of the large quantities handled, the bulk bulbs were tipped direct into the field and spread, so that they were rapidly cooled and dried by the action of sun and air.

To test the assumption that treated bulbs ought to be allowed to cool slowly and with minimum exposure to weather, the following experiment was carried out.

Two large samples (A and B) of *N. poeticus ornatus* were given the usual three hours treatment at 110° F. A third sample (C) was obtained from Tresco, where the bulbs had been similarly treated in a thermostatically-controlled apparatus.

Sample (A) was cooled and dried in the packing shed on a concrete floor.

Sample (B) was cooled and dried out of doors, in a small area between buildings, where the bulbs were not much exposed to the weather.

Sample (C) was spread on concrete in an exposed position. The weather was stormy at the time and several rain squalls occurred before the bulbs were cool.

Between fifty and sixty bulbs were taken from each sample and examined several weeks after being subjected to the hot-water treatment. When cut open the condition of the flower buds was recorded, with the following significant results :—

Sample (A). The flower buds had continued to develop and the bulbs were entirely undamaged.

Sample (B). The buds destroyed by the exposure amounted to 12·76 per cent. of the total flower buds

Sample (C). The extent of the injury was considerably greater than anticipated, no less than 42·6 per cent. of the flower buds being destroyed.

It is not sufficient, therefore, to bring the bulbs to a dormant state by thorough ripening and to attend carefully to the application of the hot-water process. If the full benefit of the treatment is to be obtained, it is essential that the cooling should be gradual and that there should not be undue exposure. In the case of non-flowering bulbs, such care may

not be necessary, and more latitude in the condition of the bulb may be permissible. When cool, every effort should be made to dry the bulbs by frequent turning and exposure to light currents of air. The grower will soon find the most convenient method of doing this with the means at his disposal.

The attack of moulds, such as *Pencillium*, after hot-water treatment, is common amongst bulbs which have been badly damaged by eelworm, and a certain amount of loss must be expected during drying from this cause, although the eelworm may be destroyed. This should not occasion undue alarm, as it is improbable that such badly-damaged bulbs would grow in any case. If the drying is neglected, however, these moulds will spread to other bulbs, causing loss that greater attention might avoid.

Those growers who have no experience of the hot-water treatment of bulbs will be interested to know that the process appears to stimulate the bulb, and the subsequent growth is usually more vigorous than would otherwise be the case. There is also the added advantage that mite and the larvæ of the narcissus flies are killed.

Appearance of Attacked Bulbs after Treatment.—On cutting transversely through a bulb which has been badly injured by eelworm attack, the damaged tissue will be seen as brownish marks or rings round the bulb scales. If these bulbs are properly put through the hot-water treatment, the eelworm and eggs are destroyed. Subsequent examination, after a complete season's growth, shows that these rings are still present, but this does not prove that the treatment has not been entirely satisfactory. Generally, the rings will have darkened, and the outer edges of the marks will no longer show the pale discoloration usual where damage by eelworm is still in progress. These dead cells may now be full of mycelium, in which case the damaged areas may be blackened. It is only after several years, when sufficient new scales have been formed from the growing point within the bulb, that the old damaged scales will be thrown off.

Tabular Description from Experiments.—Any variation of the usual treatment is recorded in the tabulated notes. It will be observed that many of the bulbs were treated by placing them in bags in the containers instead of loose, and this arrangement would appear to be satisfactory providing the bags are not too full of bulbs. The temperatures recorded

under " Details of Treatment " were taken by special maximum thermometers plugged into the bulb and are accurate to within a quarter of a degree. In making the " Field Observations," great care was taken to record the slightest blemish, whether this might be attributable to the hot-water treatment or not. Further, it should be borne in mind that practically all the bulbs treated were known to be infested with eelworm, and in many cases the attack was in an advanced state. Although the samples came from some of the most heavily-infested gardens, in no instance was any sign of eelworm injury visible during 1925 after treatment, and the growth and flowering were very satisfactory.

It is, perhaps, desirable to reiterate that, where the numbers of eelworm present are very small, the lightly-infested plant may appear normal, so that close observation should be continued throughout the second year's growth for any signs of a recurrence of the diseased state before it can be safely inferred that the stocks have been completely freed from eelworm.

Deductions from Experiments.—(1) Close examination of the tabular data shows that the resistance to the hot-water treatment varies with different varieties of narcissus.

(2) That a temperature below 110° F., even if maintained for some hours after the standard treatment, does practically no harm. Rapid cooling, however, acts deleteriously and may destroy the flower buds.

(3) Whether the bulb has been thoroughly ripened and is dormant is more important than the date at which the treatment is carried out.

(4) Injury to the flower bud seems to be connected less with the size in any given variety than with the state of the bulb at the time of treatment as indicated in (3) above. Where the bud fails to develop or a blind bud is pushed up, examination shows that development has been stopped by atrophy of the ovules within the ovary.

(5) Where the bulbs are not of flowering size, considerable latitude in handling is possible and the bulbs may be expected to make vigorous growth. In the writer's experience, small bulbs, allowed to remain at the bottom of the treating tank and reheated and re-cooled for a week, have been grown successfully.

OBSERVATIONS ON VARIETIES OF NARCISSUS GROWN AFTER CONTROL TREATMENT OF BULBS

Standard Treatment = Immersion for three hours in water maintained at a temperature of 110° F.

Sample No.	Variety	Condition when received	Date treated 1925	Details of treatment	Field observations made March 3 and April 3, 1926
1	Soleil d'or	Forced bulbs, thoroughly dried off. Treated in 1923, but inadvertently mixed with other attacked bulbs	July 1	Standard	Flowers good, early and absolutely undamaged. Growth excellent
1A	Soleil d'or	Part of same batch as 1	July 1	Standard, but left in container to drain. Internal temperature of bulb, 2 hours 20 mins. later, 93° F.	Flowers good, early and absolutely undamaged. Growth excellent
7	Soleil d'or		July 9	Treated in sacks. Maximum internal bulb temperature bottom of container 112·25° F.	Flowers good; undamaged
9	Soleil d'or		July 9	Treated in sacks. Maximum 110° F. top and 109·2° F. bottom	Flowers perfect
			July 10	Maximum 110·3° F.	
10	Soleil d'or		July 11	Maximum thermometer reading 109·5° F. Tipped in a heap on floor. Sample taken 5 hours 20 mins. later. Temperature, centre of bulb, 102° F.	Did not flower freely. Flowers in perfect condition. No foliage injury

Sample No	Variety	Condition when received	Date treated 1925	Details of treatment	Field observations made March 3 and April 3, 1926
13	Soleil d'or	Flower buds, which develop late in this variety, now easily discernible	August 12, 13	Bulbs loose in container Maximum therm in no case above 110 5 F.	A few flowers not quite normal; certainly better than Scilly White, Sample 12
14	Soleil d'or	Bulbs not fully ripened	August 13		Corolla tube frequently split. Petals none too good. Princeps rogue perfect
2	Emperor	From open ground, recently lifted	July 2	Standard	50 per cent. trumpet and perianth pieces badly distorted; others perfect. Princeps rogues uninjured
17	Emperor		July 15	Standard Maximum therm in no case above 110 5° F.	Looking well; flower buds full. Perfect flowers, plant strong
31	Emperor		Sept 3	Standard	Characteristic markings on foliage due to treatment. Buds full. A Princeps flower perfect Flowers marketable, perianths not well developed, slightly notched
32	Emperor		Sept 4	Standard	Foliage as 31 Perianths slightly notched, rather small flowers but plant rather poor

Sample No.	Variety	Condition when received	Date treated 1925	Details of treatment	Field observations made March 3 and April 3, 1926
34	Emperor		Sept. 4	Standard	Foliage marked by treatment. Flowers good. Rogues in flower perfect, one Sir Watkin fine
36	Emperor	Bulbs in good condition	Sept. 6	Standard	Foliage as 34. Big sample, two flowers damaged. Of rogues, Soleil d'or badly damaged; Empress and several Sir Watkin, perfect
3	Golden Spur	Forced bulbs in poor condition Said to have been over-watered	July 3	Bulbs in small bags. Maximum internal tem. of bulb at top of container 112·75° F., at bottom, 112·9° F. (Main thermometer out of order. Re-set for next batch)	Did not flower. Foliage weak. Apparently healthy. One rogue Emperor flower small
23	Golden Spur	Not properly ripened	August 20	Standard	Flowers perfect. Rogue Princeps flowers perfect
35	Golden Spur	Bulbs in good condition	Sept 5	Standard	Perfect flowers and foliage
43	Golden Spur		Sept. 12	Standard	Flowers perfect. Of rogues Princeps, a few Ornatus and one Orange Phœnix flowers perfect
4	Princeps	Forced bulbs	July 3	Standard	Healthy; only flowers perfect. One rogue Emperor flower damaged

Sample No.	Variety	Condition when received	Date treated 1925	Details of treatment	Field observations made March 3 and April 3, 1926
37	Princeps	Lifted rather late and rested for about a fortnight before treating	Sept. 8	Standard	Flowers perfect. One rogue Emperor flower perfect
40	Princeps		Sept. 9	Standard	Not damaged in any way
5	Obvallaris	Bulbs in poor condition after forcing	July 9	Treated in sacks. Maximum internal bulb temperature 111·75° F top and 111·9° F. bottom	Did not flower. Foliage looking well
42	Obvallaris	Eelworm discovered late. Lifted at once and treated. Large sample	Sept. 9, 10, 11, 12	Standard	30 per cent. flower buds blind. Foliage excellent. Where flowered, blooms perfect. Of rogues, where flowered, Princeps, C. J. Backhouse, and Berkeley blooms perfect
6	Rev. M. J. Berkeley	Bulbs in poor condition after forcing	July 9	Standard	Two flowers only, both perfect
27	Rev. M. J. Berkeley		Sept. 2	Standard	Uninjured. Three rogue Emperor flowers rather small petals, slightly notched in places
28	Rev. M. J. Berkeley	Picked bulbs, from different source to 27	Sept. 2	Standard	Two or three blind buds. Remainder produced perfect flowers
39	Rev. M. J. Berkeley	Lifted rater late and rested for about a fortnight before treating	Sept. 8	Standard	Flowers and foliage undamaged
8	Frank Miles		July 9	Standard	Several flowers with injured petals and corolla

Sample No.	Variety	Condition when received	Date treated 1925	Details of treatment	Field observations made March 3 and April 3, 1926
11	Ornatus		July 15	Treated in sacks Two hours only at 110° F	Flower buds full ; apparently healthy. Flowers perfect ; foliage looking well
19	Ornatus		August 1.	Two hours only at 110° F.	Rather weak, flower buds looking well. Sample weak flowers perfect
30	Ornatus	Fine bulbs	Sept. 2	Two hours only at 110 °F	Buds full. Flowers practically perfect. Petals inclined to be notched in places
44	Ornatus		Sept 12	Two hours only at 110° F.	Foliage excellent. Flowers perfect, two buds failed to open
48	Ornatus	Very heavily infested with eelworm Given to Experimental Station, grower being afraid to plant, even after treatment	Sept. 6	Two hours only at 110° F. Cooled and dried on packing shed floor	Growth satisfactory. Very few flowers. Some excellent flowers of Emperor and Barrii rogues
12	Scilly White		July 16	Treated in sacks. Maximum internal bulb temperatures, 110·25° F. at top, 110·75° F. at bottom	Flowers nearly perfect but corolla slightly split in places
21	Scilly White	Not properly ripened	August 2(	Standard	Corolla and petals badly distorted. Foliage strong and healthy

Sample No.	Variety	Condition when received	Date treated 1925	Details of treatment	Field observations made March 3 and April 3, 1926
15	Barrii	Stock very mixed	August 14	Standard	Two flowers perfect. Of rogues, some excellent Spur and Princeps; Leedsii cup not quite perfect
16	Barrii	Bulbs in bad condition	August 15	Standard	Flowers perfect; foliage strong and healthy, recovering well. Of rogues Incomps. and Princeps perfect
18	p. præcox		August 15	Standard	Full flower buds. Mostly Ornatus flowers, excellent and plant healthy
20	C. J. Backhouse		August 19	Standard. Some treated loose, others in sacks	A few perianth pieces slightly crinkled but barely noticeable. A Berkeley rogue perfect
20A	C. J. Backhouse	Of same batch as 20	August 19	Six hours at 110° F	Very like No. 20. Injury to petals slightly more apparent. One flower small and failed to develop. A Sol. rogue not perfect
20B	C. J. Backhouse	Of same batch as 20	August 19	Four hours at 110° F., followed by two hours immersion in cool water, 65° to 70° F	As in No. 20. Three rogue Emperor flowers, one slightly dwarfed
22	Gloriosus	Not properly ripened	August 20	Standard	Corolla tube split; petals poor. Damage not very obtrusive in this variety
29	Gloriosus	Bulbs had produced green shoots 1 to 1½ inches long	Sept. 2	Standard	Corolla split badly, petals small. One bud blind. Several leaves mottled. One rogue Barrii flower perfect

Sample No.	Variety	Condition when received	Date treated 1925	Details of treatment	Field observations made March 3 and April 3, 1926
24	Sir Watkin		August 20	Standard	Foliage damage by treatment. Buds full. Flowers very fine. One Cynosure rogue bloom also perfect
41	Sir Watkin		Sept. 9	Standard	Perianths possibly slightly crinkled. Flowers perfect
25, 26	Henry Irving		Sept 2	Standard	Very fine. Princeps and Golden Spur rogues perfect
33	Empress		Sept. 4	Standard	Foliage uninjured. Stock mixed. Flowers rather small. Of rogues, Princeps perfect, one Cynosure and one Emperor excellent
45	Victoria	Well ripened in green-house	Sept. 12	Standard	Flowers and foliage perfect
46	Horace	Well ripened in green-house	Sept. 12	Standard	Irregular, buds pushing up full and apparently undamaged. Excellent flowers growing very well. One blind flower bud
47	King Alfred	Well ripened in green-house	Sept. 12	Standard	Perfect flowers; two a little dwarfed. Occasional slight marks on foliage

No -Tazetta compressa, Lucifer, and Hora 'or Expe nental Station, were a o subjected to Standard itment and markete without comment. The two first variet were no nal in every way; the Horace flowers were perl but a s proporti of he buds were blind.

SEPTEMBER ON THE FARM

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Seasonal Notes.—When the year began with March, as in ancient Roman and other early calendars, the seventh month was rightly named Sept-ember. Now that the year begins two months earlier, however, the name is inappropriate. In Saxon times this was called Gerstmonat. "Gerst" meant barley (beer-legh), to which crop additional importance was attached because beer then held the place that tea now holds as the common table beverage; tea was introduced into this country about the middle of the seventeenth century.

On the average of seasons, September ranks as one of the dry months and in both early and late districts a good spell of dry weather at this time of the year is greatly appreciated, in the late parts to allow of the completion of corn harvest and in the early to permit of stubble-cleaning operations. Although, typically, the weather of this month is more like summer than autumn, the countryside now begins to take on appreciable signs of the approach of colder conditions. The foliage of the trees shows touches of yellow; the hedgerow berries take on their scarlet colours; fruit and nuts are now ripe; and stooks, bare stubbles or perhaps newly-turned soil mark the place where a month ago golden corn waved. Swallows betray the well-known symptoms of their impending departure; starlings return to their evening quarters in large flocks; the nights become chilly and leave the grass heavily laden with dew in the morning, and on the characteristic still September day, the weather-web spider streams its silken threads high in the air.

Land Operations.—Little sowing is done in September. It is now too late for catch crops, excepting rye or rye grass, which may be put in on well manured land for the production of green food in April and the beginning of May. In some districts also grass and clover seeds may be sown after second early potatoes, but elsewhere the red clover is apt to fail if sown later than August. The end of September is considered a favourable time for drilling wheat on bare fallows, and this is supported by the results of recent work on the wheat bulb fly: the early sown plant tillers well and may make a good crop even if the pest does destroy about half of the shoots. This insect, it should be explained, lays its eggs on bare or incompletely shaded ground during the latter part of the summer.

Winter beans may also be sown early in the autumn. Peas, however, winter best if sown in November.

On farms where the bulk of the manure is applied for corn crops, as on many eastern counties arable farms, the fold yards are now cleared and the manure spread on lea stubbles before ploughing for wheat. The lea stubble is, of course, most easily covered if it has been well grazed off; but in any case it is considered essential that the ploughed furrow should lie about five weeks to become "stale" before it receives the wheat seed. In some districts the furrow press is used to consolidate the ground, but probably the heavy Cambridge roller is the most common implement used for that purpose, now that drilling has taken the place of broadcasting. The exact cause of the need for the resting period of five weeks is not well understood; but probably the need for moisture and for the production of available plant food (by decay of the grass and clover roots) are two of the causes. The avoidance of frit fly by earlier ploughing is another matter.

Seeded stubbles do not as a rule call for attention this month, except on light soils where rolling is believed to be beneficial. The application of lime or phosphates, if not given to the nurse crop, is commonly deferred until after the maiden seeds have been grazed. Whether a thin plant could be strengthened by a stimulant in September is a matter for experiment.

The working of stubbles that do not contain maiden seeds is an item of much importance in the programme for September, but the possibility of its execution depends very much on weather conditions.

In some districts the ordinary practice is to take two corn crops after folded roots, the second corn crop being barley, intersown with rotation seeds. Under present conditions—the relative prices of wheat and malting barley—the tendency is to substitute winter wheat for the ordinary spring-sown barley crop. This adds to the congestion of autumn operations; but on good land a first corn stubble after roots should not require a great deal of cleaning. Sometimes hand forking is the best and most economical process, *i.e.*, where the twitch is confined to small patches. On poorer soils, seeding down in a second corn crop, which is contrary to "the custom of the district" in some parts, results in the land becoming very foul by the time the lea comes to be ploughed up. As a general rule a second corn crop, even after roots, will be improved by the use of a complete mixture of fertilisers applied in the autumn, and where conditions are not good enough to produce a heavy crop of

Yeoman, preference may be given to Little Joss, Fox, Standard Red or one of its relatives.

As regards stubbles following leas, where potatoes come next in the rotation cleaning operations may be deferred if necessary, the weeds being extracted in spring ; but where another crop of wheat is to be taken stubble cleaning and fertilising as mentioned in the preceding paragraph are generally necessary. The stubble of second corn crops after seeds, however, generally —and as may be expected—contains the most weeds. In farm valuations, land is not termed " foul," no matter how full of weeds, if, in the customary rotation it is due to be cultivated as fallow or with a fallow crop in the ensuing year. In September the farmer makes a survey of the land intended for roots or other cleaning crop in the following season. The least foul parts are chosen for mangolds and if possible cleaned in the autumn ; parts of a more weedy nature may be left for the present, being intended for swedes or turnips, which are sown later than mangolds or sugar beet ; a third section may be very dirty : this may be sown in autumn with a vetch, beans and cereal mixture, to be mown for hay or silage next June or July and afterwards bastard fallowed. If the weedy stubble is well ploughed with a specially effective skim coulter and the smother crop is liberally fertilised, this method may be very efficient as a weed destroyer.

September Grazing.—Although pasture grass forms such an important part of the diet of farm animals, it is only in recent years that the nutritive properties of pasture herbage have received much scientific investigation. About ten years ago Hughes analysed cuts of grass taken from a pasture at intervals throughout the grazing season ; in 1920-23 Fagan made similar analyses of many pure cultures of different species of grasses grown at the Aberystwyth Plant Breeding Station ; and more recently investigations have been carried out at the Rowett (Aberdeen) and Cambridge Animal Nutrition Institutes. The results all agree in not showing that gradual diminution in protein content which we have hitherto believed to occur with the advance of the season. The common recommendation to increase the proportion of protein in the concentrates used for autumn feeding, therefore, is not well founded. Autumn grass is rich in that constituent.

Nevertheless it is well known and not disputed that there is a reduction in the rate of live weight increase of stock or of milk yield in the case of cows on autumn as compared with early

summer pasture. This may be due in part to the diminished quantity of keep, to the lower temperatures, especially at night, and to the heavy dews with which the grass is commonly laden on autumn mornings. Perhaps the chief cause, however, is a simpler one—the shorter days and longer nights: the animals have not such a long period of daylight in which to graze. Supplementary foods are, therefore, necessary to make up the deficiency.

Where marrow-stem kale or similar soiling crop has been grown for autumn feeding, it is obviously better not to throw the food out to the cattle for consumption during the daytime when they should be grazing. The forage should be thrown out in the night pastures, to which the cattle have access only after the evening milking.

Milk Secretion.—It is a matter of common knowledge that a "dry" cow comes into lactation again immediately after calving; and heifers begin to yield milk after their first normal or aborted calf. Maternity is clearly the prime incentive to milk production. When we seek to know how maternity brings the milk glands into action, however, we find ourselves in the realms of theory. Many attempts have been made to find a substance—a galactagogue—whether food or drug that would be capable of exciting the mammary organs, but the search has so far yielded little positive result. There is no doubt, however, that the udder is susceptible to external influences. The effect of quick and efficient milking has been previously mentioned in these notes. It is not generally known, however, that the mammary glands of a heifer that has not yet calved may be influenced in their development by manipulation before as well as after calving. Whether manipulation would be generally beneficial remains to be proved, but its possibilities were recently strongly suggested to me by the case of a cross-bred Friesian heifer which had been in milk for at least three months and had not yet had a calf or aborted. The cause of her being in milk was apparently the fact of her having been sucked by a strong calf that grazed in the same field as she occupied. On observing the calf sucking, the farmer found that the heifer was yielding normal milk. He therefore brought her in with the dairy herd. When being milked twice a day she yielded over 30 lb. at the two milkings. When I saw her on August 9 she was being milked only once a day in the hope of turning her dry; but her daily record was still about 15 lb.

MONTHLY NOTES ON FEEDING STUFFS

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The Nutritive Value of Pasture Grasses.—In view of the extent to which pasturage conditions form a normal part of English farming practice, it is somewhat remarkable that so little attention has been given by scientific workers to this important branch of agriculture. Possibly this may be due to the prevalence of the erroneous opinion that grassland farming consists chiefly of "looking over a gate." If this be so, "looking over a gate" should be regarded as a highly skilled occupation, since efficient management of a pasture requires a greater amount of skill and needs considerably more forethought and care than management of an arable field. The scant attention given by research workers to pasture-land problems is possibly due to the fact that previous attempts to solve pasture-land problems have met with little success, the results obtained being of such a nature as to discourage further progress.

At the beginning of the nineteenth century, an interesting series of experiments on the palatability and yield per acre of different varieties of grasses was carried out by the 6th Duke of Bedford, and the results were recorded in the series of lectures given by Sir Humphrey Davy under the auspices of and published by authority of the then Board of Agriculture. As soon, however, as science began to take an interest in agriculture the investigations were concentrated chiefly on meadow hays, since the yield of a grazed field was a difficult thing to estimate, and there was no clear-cut distinction existing in the minds of research workers between pasture land as such and meadow land. The work of Thaer, Wolff, Kellner, and other workers established the nutritive value of different types of meadow hay and fresh grass, and attempts were made to estimate the losses of nutritive value that occurred in the conversion of grass to hay.

The first serious attempt to ascertain the feeding value of a pasture was made by Somerville, who, in his "manuring for mutton" experiments, measured the feeding value of a pasture by the amount of meat it would produce when grazed. Hall, Russell, and others attempted to ascertain why pastures differed considerably in their capacity to fatten cattle and sheep, and established the fact that the feeding value depended,

DESCRIPTION	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British..	—	—	14 5	0 15	13 10	72	3 9	2·01	9·6
Barley, British feeding ..	—	—	9 10	0 12	8 18	71	2 6	1·34	6·2
„ Canadian No. 4 Western	31 9	400	8 18	0 12	8 6	71	2 4	1·25	6·2
„ American	30 9	„	8 12	0 12	8 0	71	2 3	1·20	6·2
„ Russian	30 0	„	8 8	0 12	7 16	71	2 2	1·16	6·2
Oats, English, white	—	—	10 7	0 13	9 14	60	3 3	1·74	7·6
„ „ black and grey	—	—	10 0	0 13	9 7	60	3 1	1·65	7·6
„ Scotch, white	—	—	11 3	0 13	10 10	60	3 6	1·87	7·6
„ Canadian No. 2 Western	28 9	320	10 2	0 13	9 9	60	3 2	1·70	7·6
„ „ No. 3 „ ..	26 9	„	9 7	0 13	8 14	60	2 11	1·56	7·6
„ „ feed	25 3	„	8 17	0 13	8 4	60	2 9	1·47	7·6
„ American	25 3	„	8 17	0 13	8 4	60	2 9	1·47	7·6
„ Argentine	24 0	„	8 8	0 13	7 15	60	2 7	1·38	7·6
„ Chilian	24 3	„	8 10	0 13	7 17	60	2 7	1·38	7·6
Maize, Argentine	37 0	480	8 13	0 12	8 1	81	2 0	1·07	6·8
„ South African	36 9	„	8 12†	0 12	8 0	81	2 0	1·07	6·8
Peas, English maple	—	—	12 0	1 7	10 13	69	3 1	1·65	18
Dari, Bombay	—	—	11 10	0 15	10 15	74	2 11	1·56	7·2
Millers' offals—									
Bran, British	—	—	5 12	1 6	4 6	42	2 1	1·12	10
„ broad	—	—	6 12	1 6	5 6	42	2 6	1·34	10
Middlings, fine, imported ..	—	—	7 12	1 1	6 11	69	1 11	1·03	12
„ coarse, British ..	—	—	6 15	1 1	5 14	58	2 0	1·07	11
Pollards, imported	—	—	5 10	1 6	4 4	60	1 5	0·76	11
Meal, barley	—	—	9 15	0 12	9 3	71	2 7	1·38	6·2
„ maize	—	—	8 15	0 12	8 3	81	2 0	1·07	6·8
„ „ South African ..	—	—	8 5	0 12	7 13	81	1 11	1·03	6·8
„ „ germ	—	—	8 5	0 18	7 7	85	1 9	0·94	10
„ „ gluten feed ..	—	—	8 7	1 6	7 1	76	1 10	0·98	19
„ locust bean	—	—	9 0	0 9	8 11	71	2 5	1·29	3·6
„ bean	—	—	12 0	1 11	10 9	66	3 2	1·70	20
„ fish	—	—	18 5	4 1	14 4	53	5 4	2·86	48
Maize, cooked flaked	—	—	11 5	0 12	10 13	85	2 6	1·34	8·6
Linseed	—	—	19 0	1 10	17 10	119	2 11	1·56	19
„ cake, English, 12% oil	—	—	12 12	1 16	10 16	74	2 11	1·56	25
„ „ „ 10% „	—	—	12 5	1 16	10 9	74	2 10	1·52	25
„ „ „ 9% „	—	—	12 0	1 16	10 4	74	2 9	1·47	25
Soya bean „ 6% „	—	—	12 0	2 11	9 9	69	2 9	1·47	36
Cottonseed cake, English, 5½%„	—	—	6 2	1 13	4 9	42	2 1	1·12	17
„ „ Egyptian, 5½% „	—	—	5 15	1 13	4 2	42	1 11	1·03	17
Decorticated cottonseed cake, 7% oil	—	—	10 0	2 11	7 9	71	2 1	1·12	34
Decorticated cottonseed meal, 7% oil	—	—	10 0	2 11	7 9	74	2 0	1·07	35
Coconut cake, 6% oil	—	—	8 15	1 10	7 5	79	1 10	0·98	16
Ground nut cake, 6% oil ..	—	—	7 5	1 15	5 10	57	1 11	1·03	27
Decorticated ground-nut cake, 7% oil	—	—	11 10*	2 13	8 17	73	2 5	1·29	41
Palm kernel cake, 6% oil ..	—	—	6 15	1 2	5 13	75	1 6	0·80	17
„ „ „ meal, 6% oil	—	—	7 5	1 2	6 3	75	1 8	0·89	17
„ „ meal, 2% oil ..	—	—	6 0	1 3	4 17	71	1 4	0·71	17
Feeding treacle..	—	—	5 15	0 9	5 6	51	2 1	1·12	2·7
Brewers' grains, Dried ale ..	—	—	6 17	1 3	5 14	49	2 4	1·25	13
„ „ „ porter ..	—	—	6 7	1 3	5 4	49	2 1	1·12	13
„ „ Wet ale ..	—	—	0 14	0 9	0 5	15	0 4	0·19	4·8
„ „ „ porter .	—	—	0 11	0 9	0 2	15	0 2	0·09	4·8
Malt culms	—	—	6 7	1 13	4 14	43	2 2	1·66	16

*At Hull †At Liverpool

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of July and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 8d.; P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

among other things, upon the nature of the flora of the mixed herbage and the habit of growth.

In 1924 Prof. T. B. Wood had occasion to inquire into the literature relating to pasture grasses, and was struck by the fact that very little work had been carried out on this very important subject, and as a result he was led to initiate the important investigation into the nutritive value of pasture now being carried out at Cambridge. An interim report has been published by Woodman, Blunt, and Stewart,* embodying the results of the first year's work.

It is not intended to deal exhaustively with the results of this work here: those interested should consult the original paper for full details and discussion. Briefly, the investigation, which was carried out on a pasture field situated on a light sandy soil, consisted in the close cropping of the field at short intervals, so as to approximate as closely as possible to actual grazing conditions, and to ascertain the total weight and food value of the herbage obtained throughout the season. In addition, digestibility determinations and mineral analyses of the herbage were carried out with two sheep, so that full knowledge of the nutritive value of the pasture yield was obtained throughout the season. From the results of the investigation obtained so far the following points of practical interest emerge :—

(1) Under the meteorological conditions existing in 1925 the yield of the pasture showed a close correlation with the rainfall during the mid-season, a result that one would anticipate on a pasture field of this character, *i.e.*, a medium quality field on soil of a light sandy character.

(2) The continual close mowing of the field led to a large development of white clover, and improved the quality of the herbage enormously, a fact that strongly supports the practice of close grazing.

(3) The weight of hay obtained from the control plots (hay and aftermath) was considerably more than the weight of pasture produced by the close-mowing method. This apparent superiority of the control hay plot is, however, an illusory one, since the value of the pasture approximates to that of a concentrated feeding stuff, whereas the hay has only a typical fodder value.

(4) The chief point of interest emerged from the digestibility

* "Nutritive Value of Pasture." H. E. Woodman, D. L. Blunt, and J. Stewart. *Jour Agric. Sci.*, *XVI*, *p.* 205.

determinations of the pasture grass during the season. In the early part of the growing season the grass compared very favourably with a concentrate, like linseed cake, allowing for water content, and, although the nutritive value decreased as the season progressed, even the poorest quality pasture cut was still considerably superior to best quality meadow hay. In the particular season considered, the pasture improved again in quality towards the latter part of the season. It is rather remarkable to find that pasture grass, allowing for water content, ranks with the concentrates rather than with the fodders, and that we must regard it in the future as a "watered" concentrated feeding stuff.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows :—

	Starch equivalent	Protein equivalent	Per ton £	s.
Barley (imported)	71	6·2	8	13
Maize	81	6·8	8	13
Decorticated ground nut cake	73	41·0	11	10
,, cotton cake	71	34·0	10	0

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2·27 shillings, and per unit protein equivalent, 1·64 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1925, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	8 19
Oats	60	7·6	7 9
Barley	71	6·2	8 11
Potatoes	18	0·6	2 2
Swedes	7	0·7	0 17
Mangolds	7	0·4	0 16
Beans	66	20·0	9 3
Good meadow hay	31	4·6	3 18
Good oat straw	17	0·9	2 0
Good clover hay	32	7·0	4 4
Vetch and oat silage	13	1·6	1 12
Barley straw	19	0·7	2 4
Wheat straw	11	0·1	1 5
Bean straw	19	1·7	2 6

MISCELLANEOUS NOTES

Walnut Survey

THOUGH single walnut trees are common in all parts of England and Wales, walnuts are not grown on a commercial scale in this country, and the total home crop is quite insufficient to supply the home markets. Moreover, many of our walnut trees produce nuts of poor quality, a fact which is not surprising when it is remembered that most of the trees have been raised from nuts of unknown origin planted in odd ways. In other countries, it has been found possible to improve the walnuts by working scions taken from proved trees on to known stocks, and thus by vegetative means to raise a number of trees which are known in advance to be able to produce superior quality nuts. It cannot be claimed that the same method of procedure would hold good for this country, nor is it known whether the right kinds of stocks for Great Britain are in existence.

In these circumstances, the Ministry decided in 1924 to make an inquiry into the general character of the walnuts grown in this country in order to obtain a closer knowledge of existing types and to ascertain the location of the best existing varieties with a view to their subsequent vegetative propagation and wider distribution. Through the medium of County Horticultural Officers, Inspectors of the Ministry and otherwise, samples of matured nuts were collected from many parts of the country during 1924 and again during 1925, and were critically examined by Mr. Howard Spence of Ainsdale, Southport, who very kindly offered his services to the Ministry in this connection.

The following salient points from Mr. Spence's reports will, it is hoped, be of interest. He examined samples of nuts from the 1924 crop of some 160 trees. The weather of that season, characterised by excessive rainfall and lack of sunshine, was very unfavourable to the development of the walnut crop. Light crops were recorded in most districts, and malformation and distortion of shell were very prevalent in the samples received. After exposure for a week or two to normal indoor conditions, the kernels of the majority of the nuts became shrivelled and withered, and the cause of this shrinkage was found to be a shortage of the normal proportion of oil in the nuts. This deficiency was accompanied in most cases by excessive sugariness and lack of the true walnut flavour. In spite of the generally disappointing results of this year's inquiry, mainly attributable to the weather conditions, the

fact emerged that some, though but a very small number, of home-grown trees are capable even in so unfavourable a year of producing nuts with the desired characteristics in greater or lesser degree, *viz.*: good colour, size, contour, percentage of kernel and of oil, flavour, sealing, crop yield and absence of astringency and excessive moisture—and approximating to the high standard of Californian and Continental types.

In 1925, a season of more normal climatic conditions, the home walnut crop was much better both in quantity and quality than in 1924. Practically the whole of the samples received this year were free from the malformation noted in the previous year, and in many cases trees which produced small crops of poor nuts in the previous years were found in 1925 to have borne large crops of better nuts. The examination of the 1925 samples confirmed the fact that the percentage of walnut oil in the nut is the prime factor in determining quality; it also brought out another factor second only in importance, *viz.*, the original proportion of water present in the fresh kernel, which in the case of a number of the samples was excessive so that the shrinkage on partial drying was serious.

The inquiry has so far revealed a dozen types which pass the standard in these two essential factors and which are a great improvement on the large majority of home-grown walnuts. Amongst these are two or three varieties excellent for home consumption but too small for the market; one only is deemed worthy of wider general distribution. Scions of these have been kindly supplied for propagation trials mainly at East Malling Research Station, where experimental work is now proceeding on the subject of stocks and their standardisation, the best methods of propagation for home conditions, and also to determine the quality of walnuts grown here from the best foreign grafted varieties. For the purpose of these experiments, scion wood from the best varieties grown in California and in Italy has been obtained, and a number of the best types of nuts from other foreign sources have been planted.

The information gained by the inquiry proves beyond doubt the possibility, at least in the southern counties, of growing walnuts possessing the qualities essential to enable them to compare favourably with foreign types, but no one variety has yet been found in this country in which all the desired features are combined. The field covered so far has been comparatively limited, and it is now desired to extend the inquiry so as to cover as large a number as possible of our home walnut trees.

The Bingley Clean Milk Campaign, 1925

A REPORT recently issued by the Public Health Department of the Bingley Urban District Council is an example of the valuable assistance that can be given by Sanitary Authorities towards the general improvement in cleanliness of the milk supply by education and co-operation. The scheme was initiated by the Senior Sanitary Inspector as a result of his attendance at the Clean Milk Course for Sanitary Inspectors held at Leeds University in July, 1925.

The Bingley Urban District area extends to 11,675 acres, and the population is 19,380. There are 110 farmers engaged in milk production, and they have 1,578 cows housed in 209 cowsheds.

The report is written under three main headings: (1) visits to farms and educational work amongst producers, (2) bacteriological examination of milk samples, and (3) educational work amongst the consumers, and a brief summary of its contents may be outlined.

Visits to Farms and Educational Work Among Producers.—A list of milk producers in the area was prepared and arrangements made for one of the Sanitary Inspector's staff to take samples of milk from each farm. The sampling was commenced on October 6, 1925. Samples were taken by the Inspector during afternoon milking, sealed in sterile bottles, stored in a cool room over night, and dispatched to Leeds University for bacteriological examination the next day. In some cases there was a difficulty owing to inaccessibility of the farm, or time of milking, and then instructions were given to the farmer as to the method of sampling. Each farmer was notified of the result of his own sample only, and was then visited by the Inspector, together with a member of the Leeds University staff, to explain the significance of the report he had received, and to point out avenues of improvement. The farm buildings varied considerably, and many cowsheds were old, narrow, badly lit and ventilated, and difficult to keep clean. Care was taken, however, not to suggest improvements involving heavy expenditure, and stress was laid on the cleanliness of cows and cowsheds, personal cleanliness of the milkers, and the care of utensils.

Difficulties were experienced at the outset, the farmers being somewhat suspicious of the supervision; but with the scheme thoroughly explained, this attitude was changed to one of enthusiasm, and on many farms distinct improvements in

methods and equipment were shown. Regular grooming of cows and daily washing of cowshed floors was practised by many farmers, who also evinced interest in the use of covered milk pails and the erection of home-made sterilisers. The campaign was further advanced by a series of three lectures on clean milk production, each of which was illustrated with lantern slides and followed by discussions. There was a good attendance at these meetings, and a lecture on the handling of milk was likewise well attended.

Examination of Milk.—Samples of milk were taken from fifteen to twenty-five farmers on two days of the same week, and were submitted the following morning for examination; these samples constituted a group, and five of such groups were arranged. These were called "primary samples." Later in the campaign a "repeat" sample was taken from each farmer and grouped in the same manner. The results of the "repeat" samples showed that a considerable improvement had been made; *e.g.*, one group had an average bacterial count of 2,000,000 for the "primary" samples and only 52,500 for the "repeat." The improvement in regard to *bacillus coli* and keeping properties was similarly marked, as shown in the following statement dealing with the averages for the two rounds:—

	All primary samples	All repeat samples
Average bacterial count per c.c.	1.044,238	147,947
Average presence of *bacillus coli*	1/1000th c.c.	1/100th c.c.
Average keeping quality	37 hours	70 hours

The percentage of "primary" samples reaching Grade "A" standard was 24·8, and this was increased to 59·6 per cent. in the case of the repeat samples; these results indicate that whilst milk with a low bacterial count and good keeping quality can only be produced when the cows are clean, the utensils sterilised, and the milk cooled, milk of a very high standard can be produced on commercial lines, even by farmers who have comparatively poor buildings. An important note in the report is that it is necessary to arouse the interest of milkers, as without their co-operation no real progress can be made.

Educational Work Among Consumers.—The campaign was concluded with a "Clean Milk Week" from February 20 to 26, 1926. During this week a large number of lectures, mostly illustrated by lantern slides, were given to the inhabitants of the district. The National Milk Publicity Council gave very

willing assistance in the way of lecturers and the loan of slides and films, and over 2,500 persons manifested considerable interest. Leaflets on "How Milk should be Cared For in the Home" were sent to practically every home in the district, and 300 posters were exhibited.

As a result of the campaign it is evident that sympathetic co-operation with the milk trade is amply justified. Many farmers who commenced daily grooming of their cows said they were amply repaid by the improved health of their animals. One farmer has applied for a Grade "A" licence, and others have expressed their intention to do so provided the public demand increases sufficiently. The general public showed considerable interest in the campaign, and the report states that there is an increasing demand for graded milks, with the result that two local dealers have already licences to sell Grade "A."

The matter has not been left here, however. To eliminate any lapse of interest on the part of producers, the Public Health Committee have arranged with the University to continue examining samples. Individual results will be supplied as previously and will be followed by personal visits by the Inspector for discussion.

Scholarships for Agricultural Workers

THE following awards under the scheme of scholarships and maintenance grants for the sons and daughters of agricultural workmen and others are announced by the Ministry. The secondary schools or agricultural institutions last attended by the candidates are shown in brackets.

CLASS I, tenable for three or four years at University Departments of Agriculture: Sidney H. Adams (King's School, Grantham), Nigel M. Balchin (Dauntsey School), Ralph Chamberlain (Spalding Grammar School), Marjorie E. Cudmore (Okehampton Grammar School), Alexander H. Dawson (East Anglian Institute of Agriculture), Marcus H. French (Cheltenham Grammar School), William J. B. Hopkinson (University College of Wales), William E. Lancaster (Bedford Modern School), Robert P. N. Napper (Cotham Secondary School), Maurice F. Rose (Sir William Borlase's School), Ernest Shaw (Nantwich Grammar School).

CLASS II, tenable for two years at Agricultural Colleges and University Departments of Agriculture: Wilfred K. Aslet

(Peter Symond's School), Reginald W. Champion (Somerset Farm Institute), John W. Egdell (Cumberland and Westmoreland Farm School), William George Fry (Kew Gardens), Alice Hassall (Hampshire Farm Institute), Ada V. Meade (Woodford High School), Charles Gordon Pratt (Towyn Grammar School), John S. Roberts (Llysfasi Farm Institute), Reginald B. H. Round (Bromyard Grammar School), William H. Sutton (Seale Hayne Agricultural College).

CLASS III 113 Scholarships for short courses at Farm Institutes have been awarded.

The occupations of the parents of the successful candidates are: agricultural workmen 42, working bailiffs 6, smallholders 39, other rural occupations (*e.g.*, harness-maker, gardener, roadman) 22; the remaining 25 candidates qualified on their own account as *bona fide* wage-earners in the agricultural industry. The total number of applications received was 526.

The Agricultural Index Number

THE general level of the prices of agricultural produce in July was 48 per cent. above those ruling in the corresponding month of 1911-13. There was no change in the general index number as compared with June and it was only one point lower than in July last year.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921:—

Month	Percentage Increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	180	71	67	60	71	58
February	164	75	63	61	69	53
March ..	146	73	59	57	66	49
April ..	145	66	54	53	59	52
May ..	115	69	54	57	57	50
June ..	105	64	49	56	53	48
July ..	103	67	50	53	49	48
August	122	68	52	57	54	—
September	113	59	52	61	55	—
October	82	61	50	66	53	—
November	74	63	51	66	54	—
December	71	61	55	65	54	—

Live Stock.—Fat cattle were 2s. 3d. per live cwt. cheaper than in June, but as a reduction in price also occurred in the base years the index figure was unchanged at 40 per cent. above the pre-war price, as against 48 per cent. in July, 1925. Average prices of fat sheep declined by ½d. per lb. on the month

and the index number fell from 66 to 59 per cent. above 1911-13 and was 20 points lower than in July, 1925. As compared with a year ago fat sheep were about 1½d. per lb. cheaper. Bacon pigs sold at 1d. and porkers at 3d. per 14 lb. stone less than in June, and as prices rose in July, 1911-13, the index numbers dropped 4 and 6 points respectively. Fat pigs were 2s. 3d. per 14 lb. stone dearer than in July, 1925, and were about 83 per cent. dearer than in the base years, being still relatively dearer than any other class of agricultural produce which is taken into account in the calculation of the general index number. Rather better prices were realised for dairy cattle but the index number was unchanged at only 38 per cent. above pre-war values, while that of store cattle, which sold at the same average price as in June, was 33 per cent. higher than in the base years, both classes of stock being comparatively cheap and obtainable at lower figures than in July, 1924 or 1925. The index number for store sheep rose 11 points on the month to 82 per cent. above pre-war level, the decline in prices being relatively smaller than in the basic years. Prices of store pigs were slightly lower than in the previous month, but the index number was 5 points higher at 139 per cent. above the prices ruling in 1911-13. As compared with July, 1925, store sheep were 10s. per head cheaper while store pigs made 20s. per head more.

Grain.—Higher prices were realised for wheat and oats, the former averaging 6d. and the latter 4d. per cwt. more than in June, but barley was 3d. per cwt. cheaper. The index numbers of both wheat and oats rose by 2 points while that of barley declined by 4 points. Wheat was 73 per cent. dearer than in the basic period and made 2s. 1d. per cwt. more than in July, 1925, while oats, which commanded very similar prices to a year ago, were only 33 per cent. above pre-war value. Barley realised 1s. 4d. per cwt. less than in July, 1925, and was comparatively very cheap at only 17 per cent. more than in the basic period.

Dairy and Poultry Produce.—The contract price for milk delivered to London, Birmingham and Manchester was again unchanged at 1s. per gallon, this price representing an increase of 60 per cent. over July, 1911-13. Butter was 1d. per lb. dearer than in June, while cheese was slightly cheaper, the index number of the former rising 2 points while that of the latter fell 2 points. At 78 per cent. above the pre-war price cheese was somewhat dearer than a year ago, but butter, which was 56 per cent. above, was about 10 per cent. cheaper.

Eggs made 2½d. per dozen more on the month, and as this increase was proportionately greater than in the base years the index figure showed a rise of 7 points to 33 per cent. above pre-war cost, the latter figure being as much as 28 points below that of a year earlier.

Other Commodities.—Owing to the change over from old crop potatoes to this season's first early varieties, potatoes averaged £2 5s. per ton more than in June, but prices were low, being only 21 per cent, above those obtaining in July in the base years. As compared with July, 1925, potatoes were cheaper by about £1 4s. per ton. Cauliflowers were much cheaper than in the previous month, but even then were nearly double the pre-war price, while cabbage was dearer and realised 120 per cent. more than in the basic years. Strawberries in July were 46, gooseberries 62, raspberries 81, red currants 61, black currants 136, and cherries 37 per cent. dearer than in the basic period. As mentioned in last month's article, vegetables and fruit are not taken into account in the calculation of the general index number. Both clover and meadow hay were unchanged in price on the month, but owing to small advances as between June and July in the base years, the index numbers in each case fell 1 point, hay averaging only 8 per cent. above pre-war prices.

Index numbers of different commodities during recent months and in July, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924 July	1925 July	1926 April	1926 May	1926 June	1926 July
Wheat	47	47	57	67	71	73
Barley	52	34	18	22	21	17
Oats	28	34	26	30	31	33
Fat cattle	54	48	39	43	40	40
Fat sheep	97	79	59	67	66	59
Bacon pigs	31	51	82	88	87	83
Pork pigs	31	52	84	90	90	84
Dairy cows	56	50	39	36	38	38
Store cattle	51	42	31	29	28	33
Store sheep	132	115	60	55	71	82
Store pigs	28	53	119	122	134	139
Eggs	65	61	48	38	26	33
Poultry	80	75	46	61	70	52
Milk	50	57	95	60	60	60
Butter	60	73	49	52	54	56
Cheese	90	70	77	83	80	78
Potatoes	81	43	7	15	−5*	21
Hay	1	0	5	9	9	8

* Decrease.

Export of Breeding Stock

NUMBER and declared value of animals, living, for breeding, exported from Great Britain and Northern Ireland in the three months ended June, 1926, compared with the corresponding period in 1925. (From returns supplied by H.M. Customs and Excise.)

Country to which exported	April to June, 1926		April to June, 1925	
	Number	Declared value	Number	Declared value
CATTLE		£		£
Argentina	89	14,258	210	48 000
Belgium	0	0	15	155
Colombia	0	0	5	501
Denmark	2	150	12	380
France	10	785	0	0
Germany	0	0	16	550
Uruguay	13	2,300	36	5,310
Irish Free State .. .	1,637	19,565	1,999	25,622
Kenya Colony	3	143	9	455
Nyassaland .. .	6	260	0	0
Union of South Africa .	13	800	40	3,192
Other countries .. .	18	575	17	2,010
Total of cattle .. .	1,791	38,836	2.359	86,175
SHEEP AND LAMBS				
Argentina	2	30	58	645
Brazil	6	190	1	29
Ecuador	7	56	0	0
Germany	3	55	12	390
Spain	15	125	0	0
Sweden	0	0	30	690
Irish Free State	448	737	328	750
Union of South Africa .	0	0	15	264
Other countries	11	85	10	122
Total of sheep and lambs ..	492	1.278	454	2,881
SWINE				
Argentina	5	162	5	92
Czecho-Slovakia	0	0	6	120
France	0	0	6	120
Germany	18	534	44	1,090
Italy	5	92	17	439
Japan	0	0	7	305
Netherlands	5	150	14	471
Ceylon	0	0	6	60
Irish Free State	409	2,040	118	583
Union of South Africa ..	0	0	59	1,254
Other countries	3	80	15	228
Total of swine	445	3,058	297	4,762

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1926

ACREAGE UNDER CROPS AND GRASS AND NUMBERS OF LIVE STOCK ON HOLDINGS ABOVE ONE ACRE IN EXTENT IN ENGLAND AND WALES AS RETURNED BY OCCUPIERS ON JUNE 4, 1926.

(The figures for 1926 are subject to revision)

CROPS AND GRASS

Distribution	1926	1925	Increase		Decrease	
	Acres	*Acres*	*Acres*	*Per cent*	*Acres*	*Per cent.*
TOTAL ACREAGE under all CROPS and GRASS ..	25,675,000	25,755,000	—	—	80,000	0·3
*ROUGH GRAZINGS ..	5,060,000	5,024,000	36,000	0·7	—	—
ARABLE LAND ..	10,548,000	10,682,000	—	—	134,000	1·3
PERMANENT GRASS :						
For Hay ..	4,358,000	4,311,000	47,000	1·1	-	—
Not for Hay	10,769,000	10,762,000	7,000	0·1	-	—
TOTAL ..	15,127,000	15,073,000	54,000	0·4	—	—
Wheat	1,592,000	1,500,000	92,000	6·1	—	—
Barley	1,150,000	1,318,000	—	—	168,000	12·7
Oats	1,861,000	1,868,000	—	—	7,000	0·4
Mixed corn ..	114,800	124,400	—	—	9,600	7·7
Rye	48,000	50,100	—	—	2,100	4·2
Beans	214,200	190,800	23,400	12·3	—	—
Peas	119,200	131,200	—	—	12,000	9·1
Potatoes ..	499,500	493,200	6,300	1·3	—	—
Turnips and Swedes ..	766,400	806,500	—	—	40,100	5·0
Mangold ..	338,500	359,100	—	—	20,600	5·7
Cabbage, savoys, and kale ..	84,200	73,000	11,200	15·3	—	—
Kohl-rabi ..	10,200	10,700	—	—	500	4·7
Rape	66,800	66,100	700	1·1	—	—
Vetches or tares	97,100	88,500	8,600	9·7	—	—
Lucerne.. ..	47,000	54,000	—	—	7,000	13·0
Mustard for seed	45,300	22,800	22,500	98·7	—	—
Brussels sprouts	25,500	20,900	4,600	22·0	—	—
Cauliflower or Broccoli ..	13,300	11,700	1,600	13·7	—	—
Carrots	8,400	8,100	300	3·7	—	—
Onions	1,900	2,200	—	—	300	13·6
Celery	5,400	4,800	600	12·5	—	—
Rhubarb ..	6,400	6,200	200	3·2	—	—
Sugar beet ..	125,000	54,700	70,300	128·5	—	—
Linseed ..	2,900	3,700	—	—	800	21·7
Hops	25,600	26,300	—	—	700	2·7
Small fruit ..	69,600	68,400	1,200	1·8	—	—
Orchards ..	240,600	238,100	2,500	1·0	—	—
CLOVER and ROTATION GRASSES :						
For Hay ..	1,577,000	1,722,000	—	—	145,000	8·4
Not for Hay	925,000	852,000	73,000	8·6	—	—
TOTAL ..	2,502,000	2,574,000	—	—	72,000	2·8
BARE FALLOW ..	417,900	463,200	—	—	45,300	9·8

* Mountain, Heath, Moor, Down and other rough land used for grazing.

The total area returned this year as under crops and permanent grass on agricultural holdings exceeding one acre in extent in England and Wales is 25,675,000 acres or 80.000 acres less than in 1925. The area returned as rough grazings is 5,060,000 acres, an increase of 36,000 acres, the total area of land coming within the scope of the returns thus showing a reduction of 44,000 acres.

The area of arable land shows a further decrease but the reduction is much less than in either of the two previous years. The acreage this year is 10,548,000 acres or 134.000 acres less than in 1925 and 418,000 acres or 3¾ per cent. less than in 1915.

Cereals.—For the first time since 1921 the acreage of wheat shows an increase, the total of 1,592,000 acres being 92,000 acres larger than in 1925 and 47,000 acres above the 1924 figure. The generally favourable weather last autumn for cultivation and sowing is no doubt largely responsible for the substantial addition to the wheat area. Most counties share in the increase, but a few eastern counties show reductions. In the East Riding the wheat area is increased by over 10,000 acres and the North Riding shows an addition of 7,600 acres or over 34 per cent.

The acreage under barley this year is the smallest ever recorded, only 1,150,000 acres being under this crop, a reduction of 168,000 acres on the year. Decreases are general throughout the country, but are relatively not so appreciable in the eastern counties as elsewhere. Suffolk has maintained its area, Norfolk shows a decrease of only 3½ per cent., and Cambridge over 6 per cent., but Lincoln (Lindsey) has a decline of 15 per cent . and the East Riding one of 20 per cent., whilst the southern and northern counties average about 17 per cent., and the midlands 22 per cent. less than last year.

There is comparatively little change in the area of oats, the total of 1,861,000 acres comparing with 1,868.000 acres last year. Changes in area are very variable throughout the country but are mostly not very appreciable.

Forecasts of the yields per acre of corn crops, based on the condition of the crops on August 1, suggest that the total production of wheat, barley and oats this year will be approximately as shown in the following table. It must be borne in mind that the forecasts of the yields were made when practically all the crops were still uncut and are consequently subject to revision.

	Forecast 1926 Tons	Production 1925 Tons
Wheat	1,430,000	1,360,000
Barley	926,000	1,010,000
Oats	1,459,000	1,379,000

Beans and Peas.—More land is under beans this year, but the total of 214,200 acres, though 23,400 acres greater than in 1925, is smaller than in any other year since 1917. The acreage of peas has, however, been further reduced, being only 119,200 acres or 12,000 acres less than last year and the smallest area recorded in any year except 1916.

Potatoes.—Last year's acreage of potatoes has been fully maintained in spite of the reduced prices realised for the 1925 crop. The area returned this year as being grown on agricultural holdings is 499,500 acres, an increase of 6,300 acres. The increase is on the eastern side

of the country; Lincoln (Holland) has added nearly 4,000 acres and the Isle of Ely 2,400 acres, while Lincoln (Lindsey) and Yorkshire show additions of about 2,000 acres each. Lancashire and Cheshire, on the other hand, have rather reduced areas.

Sugar Beet.—The rapid rate of increase in the area of sugar beet has been maintained and the area under this crop is 125,000 acres, against 54,700 acres last year and 22,400 acres in 1924. The great bulk of the area is in the eastern counties, 25 per cent. of the total being in Norfolk. Only fifteen counties in the whole of England, however, have less than 400 acres under this crop this year, whereas last year there were thirty-one counties in this position.

Fodder Roots.—The area of turnips and swedes is further reduced and the total of 766,400 acres is 40,000 acres less than last year, nearly every county sharing in the decline. Mangolds also show a decrease, only 338,500 acres being under this crop against 359,100 acres in 1925. A few northern and Welsh counties have larger areas than last year, but only Yorkshire shows any appreciable increase.

Other Crops.—Some of the minor fodder crops show appreciable changes as compared with last year. Vetches cover nearly 10 per cent. more land and fodder cabbage 16 per cent. more, but lucerne is reduced by 13 per cent. There is a very large increase in the area of mustard for seed, some 45,300 acres being grown, or practically double the area in 1925, and the largest acreage since 1920. The hop acreage is reduced by 700 acres to 25,600 acres or rather less than in 1924.

Vegetables.—All the vegetable crops which are separately distinguished in the returns, except onions, were occupying a larger area on June 4 than a year earlier. Brussels sprouts show an increase of 4,600 acres or 22 per cent., and cover a much larger area than in any previous year, and cauliflower or broccoli also occupy a record area. The increase in the carrot area is small, and the total of 8,400 acres is 2,300 acres less than in 1924. The area of onions is the smallest ever recorded; the acreage in Bedford is only 400 acres against 560 acres last year.

Fruit.—The total acreage of orchards is 240,600 acres, an increase of 2,500 acres on the year. Kent has increased its area by 1,800 acres, and Worcester shows an increase of 930 acres. An addition has also been made to the acreage under small fruit, 69,600 acres being returned against 68,400 acres in 1925. Here again the largest increases are in Kent and Worcester. As last year the area of currants and gooseberries has been increased while strawberries and raspberries show reductions.

Clover and Rotation Grasses and Meadow Hay.—A reduction of 72,000 acres is recorded in the area of clover and rotation grasses, the total acreage being 2,502,000 acres. The decrease is wholly in the area mown for hay, which declined by 145,000 acres, nearly every county sharing in the reduction, whilst in practically every county more rotation grasses were grazed this year. The area of permanent grass mown shows an increase, the total of 4,358,000 acres comparing with 4,311,000 acres in 1925.

Bare Fallow.—Conditions were much more favourable for working the land this spring than a year earlier, and as a consequence the area of bare fallow shows a reduction of 45,300 acres to 417,900 acres.

LIVE STOCK

CATTLE

	1926	1925	Increase		Decrease	
	No.	*No.*	*No.*	*Per cent.*	*No.*	*Per cent.*
Cows and Heifers in milk ..	2,064,900	2,035,000	29,900	1·5	—	—
Cows in calf, but not in milk ..	294,500	299,700	—	—	5,200	1·7
Heifers in calf ..	389,500	378,400	11,100	2·9	—	—
Other cattle :—						
Two years and above ..	1,053,000	1,060,900	—	—	7,900	0·7
One year and under two..	1,221,100	1,177,700	43,400	3·7	—	—
Under one year	1,229,400	1,211,600	17,800	1·5	—	—
TOTAL OF CATTLE ..	6,252,400	6,163,300	89,100	1·4	—	—

For the fifth year in succession the number of cattle shows an increase and the total this year, 6,252,400, is the largest ever recorded. Since 1921 the herds of the country have been increased by 736,000, the addition during the past year being 89,000. The six northern counties have fewer cattle than in 1925, and several Welsh counties also show decreases, but otherwise practically every county has added to its herds. Cows and heifers in milk or in calf number 2,748,900, or 35,800 more than the record number to that date of 1925. Increases are greatest in the south and south-west, but Norfolk and Essex have additions of over 2,000. The increase in calving heifers is relatively greater than in cows, and the number of heifers in calf is the largest on record. The number of cattle above two years old is rather smaller than in 1925, but there are increases in the number of cattle from one to two years old and also in those under one year old. There are more young stock under a year old on the farms than in any pre-war year.

SHEEP

	1926	1925	Increase	
	No.	*No.*	*No.*	*Per cent.*
Ewes kept for breeding	6,752,300	6,397,100	355,200	5·6
Other sheep :—				
One year and above	2,904,500	2,872,300	32,200	1·1
Under one year ..	7,202,100	6,705,400	496,700	7·4
TOTAL OF SHEEP	16,858,900	15,974,800	884,100	5·5

A further good increase is recorded in the flocks, the total number of sheep and lambs being 16,859,000, or 884,000 more than on June 4, 1925.

The rate of increase was rather slower than in the previous two years, but the flocks have been increased by 3,421,000, or over 25 per cent. in four years, and are now only 400,000, or less than 2½ per cent., smaller than in 1914 Increases are general throughout the country, very few counties showing reductions. The number of breeding ewes was returned at 6,752,000, an increase of 355,000 on the year, while the increase in lambs was relatively greater, there being 7,202,000 lambs, or an increase of about 497,000. The increase in yearling sheep, other than breeding ewes, was quite small.

PIGS

	1926	1925	Decrease	
	No.	*No.*	*No*	*Per cent.*
Sows kept for breeding	301,100	316,500	15,400	4 9
Other pigs	1,899,100	2,327,900	428,800	18·4
TOTAL OF PIGS ..	2,200,200	2,644,400	444,200	16·8

The number of pigs on agricultural holdings shows a further decline this year to 2,200,000, but the reduction is relatively smaller in the case of breeding sows than in other pigs, an evidence that farmers had begun to keep on more gilts for breeding than was the case a few months ago before the date of the census. Practically every county shares in the reduction in the number of pigs, but the decreases are relatively smaller in the north and in Wales than elsewhere, and in these areas the number of breeding sows shows a small increase.

HORSES

	1926	1925	Increase		Decrease	
	No.	*No.*	*No.*	*Per cent.*	*No.*	*Per cent.*
Horses used for Agricultural purposes (including mares for breeding)	760,500	773,200	—	—	12,700	1·6
Unbroken horses (including stallions):—						
One year and above	125,500	148,500	—	—	23,000	15·5
Under one year	41,000	44,900	—	—	3,900	8·7
Other horses ..	201,700	197,600	4,100	2·1	—	—
TOTAL OF HORSES ..	1,128,700	1,164,200	—	—	35,500	3·0

The number of horses on agricultural holdings is again reduced, but it is satisfactory to note that the decline in breeding has not been

so rapid as in the past few years. The number of foals does, however, show an appreciable decrease, the total of 41,000 being 3,900 less than in 1925. The reductions in the previous three years were much larger, being 10,000, 11,500 and 17,500 respectively. Horses used for agricultural purposes number 760,500, or 12,700 less than last year and 31,000 less than in 1914. The increase in the number of "Other Horses" is due to a number of pit ponies, which would not normally be included in the returns, being on farms.

Agricultural Returns of England and Wales, 1926.—Acreage of Hops.—Preliminary statement compiled from the returns collected on June 4, 1926, showing the acreage under hops in each county of England in which hops were grown, with a comparative statement for the years 1925 and 1924.

Counties, &c.		1926 Acres	1925 Acres	1924 Acres
Kent	East	3,480	3,690	3,660
	Mid	5,260	5,420	5,410
	Weald	6,940	7,150	6,900
	Total, Kent	15,680	16,260	15,970
Hants		1,010	1,040	1,040
Hereford		4,150	4,190	4,100
Surrey		180	180	220
Sussex		2,390	2,420	2,390
Worcester		2,030	2,060	2,080
Other counties		110	110	100
Total		25,550	26,260	25,900

Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on August 4, at 7 Whitehall Place, S.W. 1, Mr. W. B. Yates, C.B.E., acting as Chairman in the absence of Lord Kenyon.

The Board considered notifications from the Suffolk Agricultural Wages Committee of resolutions fixing for male workers minimum and overtime rates of wages, and also special overtime rates of wages for the corn harvest, and proceeded to make Orders to operate as from Saturday, August 7, giving effect to the Committee's decisions.

The Order fixing minimum and overtime rates of wages provides, in the case of male workers aged 21 years and over, for a weekly minimum rate of 30s. per week of 50 hours in summer (first Monday in March to the last Sunday in October), and of 48 hours in winter (remainder of the year), instead of as hitherto 29s. 2d. per week in summer and 28s. in winter. In the case of adult male workers employed wholly or mainly as horsemen, cowmen, or shepherds, an additional sum of 6s. per week is payable in respect of employment in connection with the duties of feeding, cleaning, milking, bedding down, and mucking out stock. The overtime rate for male workers aged 21 years and over is 9d. per hour.

The Harvest Order provides in the case of male workers aged 21 years and over for a rate of 1s. 4d. per hour for all overtime employment on harvest work up to 75 hours. In the case of regular workers employed on farms comprising over 50 acres of corn, the Order entitles them to a sum which by the completion of the corn harvest shall have amounted to wages payable for 75 hours at the special overtime rate, provided that the workers, if so required, shall have worked during the harvest period 75 hours of overtime whether on harvest work or otherwise.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

Enforcement of Minimum Rates of Wages.—During the month ending August 15, legal proceedings were instituted against ten employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers employed in agriculture. Particulars of the cases are as follows:—

County	Court	Fines			Costs			Arrears ordered to be paid			No. of workers con-cerned
		£	s.	d.	£	s.	d.	£	s.	d.	
Isle of Wight	Newport ..		—			—		3	10	0	1
Middlesex ..	Wealdstone ..	5	0	0		—		23	0	3	3
Hereford ..	Ledbury ..		—		2	2	0	7	0	0	3
Somerset ..	Bridgwater ..		—		1	16	0	5	8	2	2
Sussex ..	Hailsham ..	0	1	0	0	7	0	2	6	6	6*
Somerset ..	Weston-super-Mare ..	2	0	0	2	12	0	19	1	0	2
Hereford ..	Leominster ..	3	0	0	2	2	0	18	19	0	2
Somerset ..	Shepton Mallet	1	10	0		—		26	0	3	3
Durham ..	Barnard Castle	1	5	0	2	14	6	11	2	8	5
Yorks (W.R.)	Barnsley ..	2	0	0	0	5	0	21	2	11	1

Farm Institute Courses.—A leaflet (Form No. 732/T.E.) showing the types of instruction available at Farm Institutes for the Session 1926/27, and the fees charged for tuition, board, and residence, has been issued by the Ministry. Copies of the leaflet may be obtained free of charge on application to the Secretary, Ministry of Agriculture, 10 Whitehall Place, S.W. 1.

* In the case heard at Hailsham, Sussex, the arrears of wages claimed were mostly due to the fact that the workers were given no weekly half-holiday nor payment at overtime rates of wages in lieu thereof. On the Bench convicting in the case of the first of the six workers the defending solicitor intimated that it was proposed to appeal, and applied for the adjournment of the remaining cases. Information has since been received from the defending solicitor to the effect that the defendant does not now propose to appeal.

Travelling Scholarships in Agriculture.—For the purpose of studying agricultural methods in this country, or on the Continent, the College or Estate Management offer a scholarship (in value not exceeding £300) for one year, open to British graduates of a British University or other person possessing qualifications approved by the Governors Candidates must be under thirty years of age on December 1 next, and will be required to give an undertaking that they intend to adopt a profession approved by the College Forms of application and full particulars may be obtained from the Secretary, College of Estate Management, 35 Lincoln's Inn Fields, London, W C 2 The latest date for submitting applications is November 30, 1926

Foot-and-mouth Disease.—27 outbreaks of foot-and mouth disease have been confirmed since the issue of the August JOURNAL, 20 of which have occurred in the Lanarkshire area already referred to Three further cases of disease have also been confirmed in Cheshire, and a new centre of disease was also discovered on August 3 at Sparkford, near Yeovil, Somerset In this area 3 further outbreaks have also been confirmed

There have now been 136 outbreaks since January 1 last, involving 21 counties, and the slaughter of 3,663 cattle, 9,367 sheep, 1,640 pigs and 4 goats

NOTICES OF BOOKS

Experimental and Research Station, Cheshunt, Herts : Eleventh Annual Report, 1925 (Cheshunt Press Ltd)

This Station, which commenced so modestly in 1914, has done such useful work as to draw support from all quarters The glasshouses have been increased, the laboratories extended, and the staff strengthened The present report gives an account of the glasshouse problems that have been tackled

Few growers would attempt to produce a tomato crop without some kind of manure, yet few would be able to say how much the size of the crop is affected by the manurial application The answer for the Lea Valley virgin soils is given in the Eleventh Annual Report of the Experimental and Research Station of Cheshunt The crop from unmanured virgin soil was but 25 55 tons per acre as against over 50 tons per acre from similar soil to which manure had been added Added manures in the second, third, and fourth years somehow fail to keep the crop up to the high level of that from new soil, and probably the most striking practical find at the Cheshunt Station during the year was that the addition of fresh grass cutting succeeded where ordinary manures failed The results point the way to a new line of investigation which should be rigorously pursued

Tomatoes growing in an atmosphere enriched by carbon dioxide gas gave increased crops in 1924, and in repeating the experiment in 1925 a similar increase of 20 per cent was obtained. Cucumber plants also gave increased crops.

The substantial increases obtained in the small chambers during these investigations are considered to be a sufficient basis for stating that given a commercial plant which could supply sufficient carbon dioxide at a moderate cost, the process is worthy of consideration from a commercial point of view

The report contains accounts of experiments of glasshouse fumigation with naphthalene to control red spider on cucumbers, cyaniding for general pest control, and the use of tetrachlorethane for the control of white fly, though growers are warned that this fumigant cannot be used with safety on chrysanthemums There is much to be learned from the experiments, and the little report should be read by all growers interested in glasshouse culture

The Aims and Work of the Hertfordshire Institute of Agriculture. (Issued by the Institute at " Oaklands " near St Albans, Herts)

Under this title a brochure, described as an " Official Work of Reference," has been issued by the Institute, giving particulars of its foundation in 1920 and of its objects and various activities The different courses of instruction, the time devoted to each branch of study, also the incentives to attain proficiency are clearly set out, and in Part II, the guiding lines, by which a number of students of very mixed social standing and education are brought to seek a common basis of individual and collective effort, are discussed at some length Briefly, the keynote is found in the desire of all the varying types of students to find work on the land, and for this the Institute, with its farm, its practical work, and its concentration on farming problems, provides the requisite opportunity to learn the immense scope and possibilities of modern agriculture Personal study and judicious reading are strongly encouraged, and weekly debates and discussions among the students, on subjects of interest connected with their chosen occupation, are a feature of the sessional work, and are found a useful stimulus to mental development With the object of making students think for themselves the class room lectures are made as informal and suggestive as possible The value of adequate recreation is also recognised as a means of developing the spirit of fair play which is so essential in farming, and all students are encouraged to make use of the facilities provided for cricket, football, tennis, and other recognised games, and in this connection there is a significant statement that " the keenest players are found to be the best students " Apart from its purpose as a training centre, the Institute is also the head quarters of the County Agricultural Education work, providing advice and lectures for farmers and horticulturists throughout the county This side of the institute's work is very extensive, and may be dealt with in more detail in a future JOURNAL article.

The Journal of the Royal Agricultural Society of England, Vol. 86, 1925 (London John Murray. Price 15s)

This latest issue of the *R A S E Journal* contains the usual quota of Official Reports, surveys of " Contemporary Affairs," and " Special Articles " In the latter section are several contributions of considerable interest Mr H W Kersey, of the South Eastern Agricultural College, and Mr C S Orwin, of the Agricultural Economics Research Institute, collaborate in an article on ' The Comparative Cost of Mangolds and Silage," as demonstrated by trials at Wye in 1922, 1923, and 1924. The results go to show that mangolds cost much more to grow than silage, but the yield of mangolds per acre is very much greater, and the loss of weight in the silo further reduces the actual food yield of the silage. Thus on the average of the three years, 29 tons of mangolds per acre were obtained at a cost of 14s. per ton. The estimated yield

of green silage per acre was 9 tons, costing £1 12s 10d per ton, but when fed the yield had diminished to 6 2 tons per acre, costing £2 7s. 10d. per ton The loss of weight in silo at Wye amounted to no less than 33 per cent , the mangold crop having thus an advantage in effective weight of nearly 500 per cent over the silage crop The authors, it should be noted, do not enter into a consideration of the respective food values of the crops Mr. A W. Ashby has an important article on "The Causes and Effect of Changes in Prices of Farm Produce," in which he comes to the conclusion that "the steadiest price level will not suffice for the equal maintenance of development of the many branches of the composite group of industries which is described as agriculture A stable price level is desirable, but within a stable price level any regulation or encouragement of a particular line of production will have to be pursued by methods adapted to the conditions of demand and supply of the individual product" Mr Fred Smith traces the descent of the Suffolk horse, the good qualities of which will he thinks, make it always "an animal desirable and useful to man" Dr B A Keen has an article on "The Use of the Dynamometer in Soil Cultivation Studies and Implement Trials," and Dr Ernest Matthews reviews "The Evolution of the Dairy Cow" Another useful contribution by Messrs Imper, Lewis, and Liversage, of the Agricultural Economics Research Institute, deals with the cost of mole draining, and gives illustrations and detailed costs of a scheme in which eighty-seven acres were so drained The cost in this instance amounted to £1 6s 8d per acre A long article by Messrs. A Bridges and R N Dixey is devoted to "A Study of the Sugar-Beet Position", and Mr J R Bond discusses the function of the Farm Institute in the scheme of Agricultural Education

BIBLIOGRAPHY ON AGRICULTURE AND RURAL ECONOMY

The following selected bibliography of recognised works, divided into four general groups, has been prepared with the intention of indicating books suitable for different classes of readers No reference is made to the extensive literature on agriculture published by the Ministry in various forms, but particulars of such may be obtained on application to the Ministry, 10 Whitehall Place, London, S W 1

GROUP I —BOOKS ON AGRICULTURE AND NATURAL HISTORY FOR THE GENERAL READER

A Pilgrimage of British Farming, *Sir A D Hall* London . Murray, 7s 6d

English Farming Past and Present, *Lord Ernle* London Longmans, Green, 12s 6d

The Land and its People, *Lord Ernle* London Hutchinson, 10s 6d

A Short History of English Agriculture, *W. H. R. Curtler* London . Oxford Univ. Press, 7s. 6d

A History of the English Agricultural Labourer, *W Hasbach* London . P. S. King, 12s. 6d.

The Village Labourer, 1760-1832, *J L. Hammond* and *B. Hammond* London : Longmans, Green, 9s

A History of the Agricultural Labourer, 1870-1920, *F. E Green* London : P. S King, 16s.

Agriculture after the War, *Sir A D Hall* London : Murray, 5s.

Food Supplies in Peace and War, *Sir R. H. Rew.* London : Longmans, Green, 6s. 6d.

Food Production in War, *Sir T. H. Middleton.* London: Oxford Univ. Press, 10s. 6d.
Rural Scotland During the War, *D. T. Jones, J. F. Duncan, H. M. Conacher* and *W. R. Scott.* London: Oxford Univ. Press, 12s. 6d.
Story Book of the Fields, *J. H. Fabre.* London: Hodder and Stoughton, 8s. 6d.
Book of Insects, *J. H. Fabre.* London: Hodder and Stoughton, 21s.
The Natural History and Antiquities of Selbourne, *G. White.* London: Allen and Unwin, 6s.
The Natural History of Some Common Animals, *O. H. Latter.* London: Cambridge Univ. Press, 6s. 6d.
Pot Pourri from a Surrey Garden, *Mrs. C. W. Earle.* London: Murray, 7s. 6d.
Rural Rides, *J. Cobbett.* London: Dent (two volumes in Everyman Series), 4s.
Toadstools and Mushrooms of the Countryside, *E. Step.* London: Hutchinson, 7s. 6d.
Wayside and Woodland Trees, *E. Step.* London: Warne, 7s. 6d.
Wayside and Woodland Blossoms (two volumes), *E. Step.* London: Warne, 7s. 6d. per volume.
Wayside and Woodland Ferns, *E. Step.* London: Warne, 7s. 6d.
Extinct Animals, *E. R. Lankester.* London: Constable, 5s.
Short Sketches of the Wild Sports and Natural History of the Highlands, *C. St. John.* London: Murray, 6s.
Social Life Among the Insects, *W. M. Wheeler.* London: Constable, 16s.
Studies in Insect Life and Other Essays, *A. E. Shipley.* London: Fisher Unwin, 10s. 6d.
Life of the Bee, *M. Maeterlinck.* London: Allen and Unwin, 6s.
The Royal Natural History (six volumes), *R. Lydekker.* London: Warne, £5 5s. per set.
Insect Transformation, *G. H. Carpenter.* London: Methuen, 12s. 6d.
The Country Month by Month, *J. A. Owen* and *G. S. Boulger.* London: Duckworth, 7s. 6d.
Round the Year, *L. C. Miall.* London: Macmillan, 4s.
Adventures Among Birds, *W. H. Hudson.* London: Dent, 6s.
Birds and Man, *W. H. Hudson.* London: Duckworth, 7s. 6d.
Birds of the British Isles and their Eggs (two volumes), *T. A. Coward.* London: Warne, 10s. 6d. per volume.
Field and Hedgerow, *R. Jefferies.* London: Longmans, Green, 6s.
Open Air, *R. Jefferies.* London: Chatto, 5s.
Wild England, *R. Jefferies.* London: Duckworth, 5s.
Wood Magic, *R. Jefferies.* London: Longmans, Green, 6s.

GROUP II.—BOOKS FOR THE SMALL HOLDER

The Small Farm and Its Management, *J. Long.* London: Murray, 7s. 6d.
Beekeeping for All, *Tickner Edwardes.* London: Methuen, 3s. 6d.
The Horticultural Notebook: A Manual of Practical Rules, Data and Tables, *J. C. Newsham.* London: Crosby Lockwood, 7s. 6d.
The Pig: Breeding, Rearing and Marketing, *Sanders Spencer.* London: Pearson, 3s. 6d.
Poultry Keeping, *C. A. Flatt.* London: Methuen, 5s. 6d.
Poultry Craft, *W. Hooley.* London: Poultry Press, 15s.
Goat-keeping on Money-making Lines, *W. Powell Owen.* London: G. Newnes, 3s. 6d.
Rabbits and All About Them, *C. A. House* and *A. Watson.* Idle, Bradford; Watmough's, Ltd., 3s. 6d.

Rabbits for Fur and Flesh, *C. J. Davies*. London : Country Life, 6s.
The Home Dressing of Furs, *E. C. Richardson*. Idle, Bradford : Watmough's, Ltd., 2s.
An Introduction to the Art of Basket-making, *T. Okey*. London : Pitman, 5s.
Rafia Work, *M. Swannell*. London : G. Philip, 3s.

GROUP III.—BOOKS FOR THE STUDENT OF AGRICULTURE AND TECHNICAL MANUALS CLASSIFIED UNDER SPECIAL HEADINGS

Agriculture, General and Miscellaneous

Foundations of Agricultural Economics, *J. A. Venn*. Cambridge Univ. Press, 16s.
Agriculture : The Science and Practice of British Farming, *J. A. S. Watson* and *J. A. More*. Edinburgh : Oliver and Boyd, 15s.
The Feedings of Crops and Stock, *Sir A. D. Hall*. London : Murray, 7s. 6d.
The Agricultural Note Book, *P. McConnell*. London : Crosby Lockwood, 15s.
The Standard Cyclopedia of Modern Agriculture and Rural Economy (twelve volumes), *R. P. Wright* (edit.). London : Gresham Publishing Co., 12s. 6d. per volume.
Agricultural Meteorology, *J. W. Smith*. London: Macmillan, 13s.
Land Drainage from Field to Sea, *C. H. J. Clayton*. London : Country Life, 6s.
Commercial Poultry Farming, *T. W. Toovey*. London : Crosby Lockwood, 6s.
Bees and Bee-Keeping (two volumes), *F. R. Cheshire*. London : Bazaar, Exchange and Mart, Vol I, 12s 6d.; Vol II, 15s.
A Practical Handbook on Rat Destruction, *C. L. Claremont*. London : John Hart, 3s. 6d.

Agricultural Chemistry

A Course of Practical Chemistry for Agricultural Students (two volumes), *H. A. D. Neville* and *L. F. Newman*. London : Cambridge Univ. Press, 21s.
The Chemistry of Crop Production, *T. B. Wood*. London : Univ. Tutorial Press, 4s. 6d.
Dairy Chemistry, *H. D. Richmond*. London : Griffin, 16s.

Agricultural Co-operation

Agricultural Co-operation in England and Wales, *W. H. Warman*. London : Williams and Norgate, 5s.
Co-operation for Farmers, *L. Smith-Gordon*. London : Williams and Norgate, 6s.
Co-operation in Danish Agriculture, *H. Faber*. London : Longmans, Green, 9s.

Botany

Agricultural Botany, *J. Percival*. London : Duckworth, 18s.
Types of British Vegetation, *A. G. Tansley* (edit.). London : Cambridge Univ. Press, 6s.
Plant Physiology with Special Reference to Plant Production, *B. M. Duggar*. London : Macmillan, 15s.
Weeds of Farm Land, *W. E. Brenchley*. London : Longmans, Green, 12s. 6d.

Buildings and Gardens

The *Country Life* Book of Cottages, *Sir L. Weaver*. London: Country Life, 9s. 6d.

The Planning and Planting of Little Gardens, *G. Dillistone*. London: Country Life, 6s.

Costing and Book-keeping

A Short System of Farm Costing, *H. R. J. Holmes*. London: Oxford Univ. Press, 6s. 6d.

Farm Accounts, *C. S. Orwin*. London: Cambridge Univ. Press, 5s.

Farm Book-Keeping, *J. Kirkwood*. Edinburgh: W. Green & Son, 6s.

Crops

Farm Crops (four volumes), *W. G. R. Paterson* (edit.). London: Gresham Publishing Co., £2 10s.

Oats: Their Varieties and Characteristics, *H. Hunter*. London: Benn, 8s. 6d.

Grassland Farming, *W. J. Malden*. London: Ernest Benn, 30s.

British Grasses and their Employment in Agriculture, *S. F. Armstrong*. London: Cambridge Univ. Press, 7s.

The Potato, *W. Stuart*. London: J. B. Lippincott, 12s. 6d.

Profitable Herb Growing and Collecting, *A. B. Teetgen*. London: Country Life, 5s.

Dairying

Dairy Farming, *J. C. Newsham*. London: Pearson, 3s. 6d.

Dairy Farming, *R. H. Leitch*. Edinburgh: W. Green & Son. 6s.

Practical Dairying, *D. G. Saker*. London: Methuen, 6s.

The Feeding of Dairy Cattle, *A. C. McCandlish*. London: Chapman & Hall, 12s. 6d.

Manual of Milk Products, *W. A. Stocking*. London: Macmillan, 16s.

Practical Butter and Cheese Making, *L. J. Lord*. London: Benn, 7s. 6d.

Practical Butter-making, *C. W. Walker-Tisdale*. London: Allen and Unwin, 3s. 6d.

Practical Cheesemaking, *C. W. Walker-Tisdale* and *W. E. Woodnutt*. London: Allen & Unwin, 3s. 6d.

Feeding Stuffs and Animal Nutrition

Feeds and Feeding, *W. A. Henry* and *F. B. Morrison*. Madison, Wisconsin: The Henry Morrison Co.; London: American Book Supply Co.

Hints on Feeding, *W. M. Tod*. London: Macdonald & Martin, 7s. 6d.

Animal Nutrition, *T. B. Wood*. London: Univ. Tutorial Press, 4s. 6d.

Fertilisers

Fertilisers and Manures, *Sir A. D. Hall*. London: Murray, 7s. 6d.

Manuring for Higher Crop Production, *Sir E. J. Russell*. London: Cambridge Univ. Press, 3s. 6d.

Basic Slags and Rock Phosphates, *G. Scott Robertson*. London: Cambridge Univ. Press, 14s.

Fruit and Vegetable Culture

Modern Fruit Growing, *W. P. Seabrook*. Chelmsford: W. Seabrook & Sons, 4s. 6d.

Fruit Farming: Practical and Scientific for Commercial Fruit Growers and Others, *C. H. Hooper*. London: Lockwood Press, 6s.

Practical Fruit Growing, *J. W. Morton*. London : Benn, 10s. 6d.
The Profitable Culture of Vegetables for Market Gardeners and Smallholders, *T. Smith*. London : Longmans, Green, 8s.
The Vegetable Garden, *M. M. Vilmorin-Andrieux*. English edition, *W. Robinson* (edit.). London : Murray, 25s.

Heredity and Mendelism

Heredity in Poultry, *R. C. Punnett*. London : Macmillan, 10s.
Mendelism, *R. C. Punnett*. London : Macmillan, 7s. 6d.
Breeding Crop Plants, *H. K. Hayes* and *R. J. Garber*. London : McGraw-Hill Book Co., 17s. 6d.

Insect and Fungus Pests

Pests of the Garden and Orchard, Farm and Forest. *R. Palmer* and *W. P. Westell*. London : H J. Drane, 25s.
The Garden Doctor, *F. J. Chittenden* London : Country Life, 7s. 6d.
Fungoid and Insect Pests of the Farm, *F. R. Petherbridge*. London : Cambridge Univ. Press, 6s.
Diseases of Glasshouse Plants, *W. F. Bewley*. London : Benn, 12s. 6d.

Livestock, General

Farm Live Stock of Great Britain, *R. Wallace* and *J. A S. Watson*. Edinburgh : Oliver and Boyd, 30s.
The Breeding and Feeding of Farm Stock, *J. Wilson*. London : Methuen, 6s.
Horses and Practical Horsekeeping, *F. T. Barton*. London : Jarrold, 10s 6d.
Points of the Horse : A Treatise on the Conformation, Movements, Breeds and Evolution of the Horse, *Capt. M H. Hayes*. London : Hurst and Blackett, 42s.
Modern Horse Management, *R S. Timmis*. London : Cassell, 15s.
The Art of Horse Shoeing, *W. Hunting*. London : Balliere, Tindall and Cox, 10s. 6d.
Cattle and the Future of Beef Production in England, *K. J. J. Mackenzie*. London : Cambridge Univ. Press, 7s. 6d.
Recent Developments in Cattle Breeding, *G. F. Finlay*. Edinburgh: Oliver and Boyd, 2s 6d.
British Sheep and Shepherding, *W. J. Malden*. London : Macdonald and Martin, 6s.
Hogs, *A J. Lovejoy* and *J. M. Evvard*. Chicago : Frost Publishing Co. ; South Godstone, Surrey ; T. A Stephens, 5s. 6d.
Douglas's Encyclopaedia for the Meat, Pork, Provision and General Food Trades. London : W. Douglas, 10s.

Machinery

Modern Farm Machinery, *D. N. McHardy*. London : Methuen, 7s. 6d.
Farm Implements and Machinery, *J. R. Bond*. London : Benn, 35s.

Marketing

Organised Produce Markets, *J. G. Smith*. London : Longmans, Green, 12s. 6d.
Efficient Marketing for Agriculture, *T. Macklin*. London : Macmillan, 12s. 6d.
Co-operative Marketing : The Golden Rule in Agriculture, *H. Steen*. New York : Doubleday, Page and Co., $1.00.
The Marketing of Poultry Products, *E. W. Benjamin*. London : Chapman and Hall, 17s. 6d.

Soil Management

The Soil, *Sir A. D. Hall*. London: Murray, 7s. 6d.
Farm Soil and Its Improvement, *Sir E. J. Russell*. London: Benn, 7s. 6d.
Agricultural Geology, *R. H. Rastall*. London: Cambridge Univ. Press, 12s.
Soil Conditions and Plant Growth, *Sir E. J. Russell*. London: Longmans, Green, 16s.

Veterinary Science

Elementary Lectures on Veterinary Science, *H. Thompson*. London: Baillière, Tindall and Cox, 10s. 6d.
Home Doctoring of Animals, *H. Leeney*, London: Macdonald and Martin, 7s. 6d.
The Farm Vet., "*M.R.C.V.S.*" London: Macdonald and Martin, 3s. 6d.
Plants Poisonous to Live Stock, *H. C. Long*. London, Cambridge Univ. Press, 8s. 6d.

GROUP IV.—BOOKS ON COUNTRY HANDICRAFTS

Samplers and Stitches: A Handbook of the Embroiderer's Art, *Mrs A. Christie*. London: Batsford, 25s.
Dress Cutting and Making, *E.* and *M. Wallbank*. London: Pitman, 7s. 6d.
Furniture Making, *R. S. Bowers*. London: Cassell, 8s. 6d.
Practical Upholstering and the Cutting of Loose Covers, *F. Palmer*. London: Library Press, 26s.
Home and Country Arts, *W. R. Lethaby*, London: National Federation of Women's Institutes, 1s.
School and Fireside Crafts, *A. Macbeth* and *M. Spence*. London: Methuen, 8s.
The Wheelwright's Shop, *G. Sturt*. London: Cambridge Univ. Press, 12s. 6d.
Leather Work: Stamped, Moulded, Cut, Cuir-Bouilli, Sewn, etc., *C. G. Leland*. London: Pitman, 5s.
Art Metal Work with Inexpensive Equipment, *A. F. Payne*. London: Batsford, 15s.
The Potter's Craft, *C. F. Binns*. London: Constable, 13s.
Hand-loom Weaving, *L. Hooper*. London: Pitman, 10s. 6d.
Weaving for Beginners, *L. Hooper*. London: Pitman, 5s.
Notes on Spinning and Dyeing Wool, *M. Holding*. London: Rural Industries Bureau, 2s.
Elementary Practical Wood-Carving, *E. Rowe*. London: Batsford, 4s.

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NOTES FOR THE MONTH

Meat Embargo

THE Minister of Agriculture is being pressed by the Dutch Government, and also by the importers of fresh meat from Holland, to withdraw the prohibition of the importation of carcasses so far as it relates to fresh meat from Holland, on the ground that the precautions taken in Holland to ensure the careful slaughtering of the animals and the cleanliness and efficient inspection of the carcasses exported to Great Britain, offer a sufficient guarantee that carcasses capable of carrying infection would not be sent to this country. It has also been claimed that experiments which have been carried out by a competent authority in Holland have demonstrated that the virus of foot-and-mouth disease does not survive in the carcasses of pigs killed in the incubative or eruptive stage of the disease.

These experiments, even if confirmed, do not affect the experience gained in Great Britain. In this country it was the practice to send to market the carcasses of such animals on an infected farm as seemed free from disease after a rigorous veterinary examination. Yet in numerous cases these carcasses proved to be carriers of infection and lighted up disease in other centres. If this can occur in Great Britain, where the outbreaks of foot-and-mouth disease are few, it is reasonable to conclude that the best inspection of carcasses in Holland, with its numerous cases, will not prevent the virus being brought therewith to this country. In this connexion it should be stated that the prevalence of foot-and-mouth disease in Holland has increased considerably during the current year. During the month of June 3,591 farms were officially reported infected.

During the war imports of carcasses and other animal products from the Continent of Europe practically ceased, and during that period Great Britain was notably free from foot-and-mouth disease. Since the conclusion of the war the importation of carcasses from the Continent has gradually assumed large proportions.

It was not until the serious outbreak of foot-and-mouth disease commenced in Lanarkshire at the end of May last that definite evidence was obtained which showed that the disease had been introduced into Scotland by infected pig carcasses. Further inquiry showed that infected pig carcasses from Belgium and Holland had arrived at several destinations in Great Britain. The disease in Lanarkshire alone has spread to forty-one different farms, necessitating the slaughter of 2,150 animals, at a cost to the State of £43,400. The cost of stamping out the outbreaks of foot-and-mouth disease which have occurred in this country in the last seven years has amounted to £5,000,000, and the tax-payers generally and agriculturists and consumers in particular have a right to demand the adoption of every possible preventive measure against the risk of re-infection from abroad.

It is not the policy of the Ministry to impose restrictions on the introduction of materials from abroad unless it has been shown by practical experience that they are liable to carry infection. This risk was conclusively proved to exist in the case of live animals during the 'eighties and 'nineties, and in consequence the importation of live cattle from the Continent was then entirely prohibited. Similar proof has now been forthcoming with respect to the carcasses of pigs from the Continent, and it has been considered imperative to impose a similar prohibition in order to protect this country from a proved channel of infection. To adopt any other policy would be contrary to the objects and intentions of the Diseases of Animals Acts, and the Minister of Agriculture would be failing in his duty of safeguarding the flocks and herds of this country from disease if he were to abandon the policy which he is now pursuing.

Imported Bacon and Ham

IMPORTERS of bacon from the Continent should take special note of the requirements of the new Order of the Minister of Agriculture which came into force on the 1st of this month (October). This Order, copies of which can be obtained from the Ministry, Whitehall Place, London, defines clearly what is meant by "fully cured bacon and ham" which is exempted from the prohibition contained in the Importation of Carcasses (Prohibition) Order of June 2, 1926.

The new Order requires that every side or piece of bacon

or ham landed in Great Britain from the Continent of Europe on or after October 1 must be labelled with a statement signed by a responsible Government official of the country in which the bacon or ham was cured, to the following effect, namely,

either (1) that the bacon or ham has been pumped with brine under a pressure of 80 lb. or more to the square inch, and subsequently soaked in brine or dry-salted for a period of not less than four days ;

or (2) that the bacon or ham has been salted (wet-salted or dry-salted) for a period of not less than ten days.

The label is required to state the name of the factory in which the bacon was cured and the locality and country in which the factory is situated. A similar label is required to be affixed also to the outside of the wrapping, crate, or other container enclosing each separate parcel of bacon or ham, so as to enable the Customs authorities to satisfy themselves that the bacon or ham is properly imported according to the Order. As bacon or ham unaccompanied by the required label will not be able to pass the Customs authorities at the ports in this country, importers should assure themselves that their shippers on the Continent are acquainted with the terms of the new Order and have made arrangements with their respective Governments for the provision of the necessary labels.

Unemployment Insurance in Agriculture

THE Inter-Departmental Committee on Agricultural Unemployment Insurance, appointed in May, 1925, by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland, with Sir Henry Rew, K.C.B., as chairman, has now reported. The Committee's terms of reference were as follows :—

"To consider and report whether it is desirable that workers in agriculture should be compulsorily insured against the risk of unemployment, and, if so, on what terms and conditions and in what manner the insurance of agricultural workers can be most effectively provided either by the inclusion of agriculture within the scope of existing legislation or by means of new legislation."

Two separate reports have been prepared, signed by six and five members respectively. The members subscribing the majority report, Sir Henry Rew, K.C.B., Mr. J. Beard, Mr. T. Denholm, Mrs. L. D. Streatfeild, C.B.E., Mr. R. B. Walker, and Mr. Denton Woodhead, have come to the conclusion that,

as regards England and Wales, the ban hitherto placed on the inclusion of agriculture within the scope of unemployment insurance should be removed. Having set forth this conclusion the majority of the Committee proceed to express the opinion that it would not be practicable to apply the existing national unemployment insurance scheme to agriculture, and that consequently a special scheme for the industry would be required.

Although the Committee had not sufficient information to enable a detailed scheme to be drafted dealing with the actuarial side of insurance, the majority report gives an indication of the general lines upon which a scheme might be constructed. It is suggested that, on the assumption that a total contribution of 6d. per week per insurable person would be adequate, one-half might be provided by the State and the other half contributed in equal proportions by employer and worker (*i.e.*, 1½d. per week each), subject to the reconsideration of State aid after a few years. As to benefits, the report suggests the inclusion of a general proviso in the scheme whereby the total amount of weekly benefit paid to an individual wage-earner in respect of himself and his dependants should in no case exceed the sum of the weekly wage he was earning when he became unemployed. So far as the administration of an agricultural Insurance Scheme is concerned, the majority report expresses the opinion that the responsibility should be entrusted to the Ministry of Agriculture, with the co-operation of the Ministry of Labour.

It is important to note that the foregoing refers to England and Wales only. The majority were impressed by the fact that there was no evidence to show that a scheme of compulsory insurance was desired by, or would be acceptable to, either employers or workers in Scotland, and accordingly are not prepared to recommend any change as regards that country.

The minority report is signed by Sir Thomas Davies, M.P., Mr. D. Black, Mr. J. Falconer, Mr. J. Gardner, and Mr. T. H. Ryland, who express the opinion that the immunity from the risk of unemployment which workers in agriculture enjoyed in 1920, when Parliament excepted the industry from the general provisions of the Unemployment Insurance Act, continues at present in no lessened degree, and moreover they believe that the existing shortage of labour will be accentuated in the future. Accordingly the members in question recommend that agriculture should continue to be excepted from the provisions of the Act.

The minority report adds that even if it had been shown that immunity from unemployment had ceased to exist or was not likely to continue, the signatories, on the grounds of the cost to the industry and the general opposition of employers and workers, would consider that agriculture should not be brought within the general provisions of the Act, and that a special scheme under the Act could not be made applicable to agriculture, and, further, that the difficulties of devising a separate scheme involving new legislation would be very great.

The Majority and Minority Reports are published in one volume, which may be obtained direct from His Majesty's Stationery Office or through any bookseller, price 6s. net.

Co-operative Marketing in the United States

UNDER an Act, approved by the United States Congress on July 2 last, a new division has been formed in the Bureau of Agricultural Economics of the United States Department of Agriculture to extend research, educational, and service work relating to co-operative marketing. The Department, through the new division, will now be able to give the same attention to the development of co-operative marketing among farmers as has been extended to problems of production. This will be done by the collection, study, and dissemination of information regarding the co-operative movement in the United States and foreign countries. Business technique and marketing methods developed by farmers' co-operative enterprises will be analysed and studied. The experience and knowledge acquired by successful co-operative marketing associations will also be studied and set forth to serve as guide-posts in the movement. Commodity co-operative marketing specialists familiar with the needs of co-operative organizations and with the research and service of the Department will be employed. These specialists will form a special contact between the 12,000 co-operatives and the Department. They will assist in the dissemination of crop and market information, data regarding price trends, and conditions of supply and demand, with such analyses and explanation as are necessary to make this information of practical value to the co-operatives and their members.

The Act enables the Department to co-operate with educational agencies. It is part of the plan, therefore, to assist

agricultural colleges and co-operative associations in working out a comprehensive educational programme in co-operative marketing. The head of the new Department is Mr. Chris. L. Christensen.

Cambridge Stubble-Cleaning Demonstration

GOOD weather conditions favoured the demonstrations of stubble-cleaning implements at the Cambridge University Farm on September 15, there being a good attendance of farmers and others interested in tillage equipment. Although the intention was to demonstrate weed killing methods of stubble cultivation, the absence of weeds in the stubbles was a matter for frequent comment; and, while this redounded to the credit of the Director of the farm, it did not enable the observer to see how the different implements would behave in really dirty land. However, the demonstrations did afford opportunities of observing how the implements treated two different classes of soil, one of which presented considerable difficulties, and of noting to what extent they succeeded in stirring the soil to the prescribed depth of 3 inches.

An interesting contrast between the ancient and the modern was seen in field C, where on one side the ponderous horse-drawn Kent plough was at work broad-sharing and laying the land up in those narrow ridges which Mr. Amos advocates; on the other side the little Simar Rototiller was busy grinding the stubble down to a fine mould. These, however, were in the nature of a side show, the tractor-drawn implements being at work elsewhere.

The soil of field H, where the morning demonstrations took place, was of a free-working nature and the stubble—wheat after potatoes—was nearly clean All the implements—including the disc harrows—readily stirred the land to the required depth, and the cultivators fitted with broad shares moved the ground over their full working width at one operation. One cultivator was fitted with special shares for leaving the soil in small ridges, and the old-fashioned Bentall type of broad share was seen equipped with miniature breasts for the same purpose.

The heavier and harder ground in field B, which was utilized for the afternoon demonstrations, proved too severe a task for the disc harrows and for some of the broad-shared cultivators, which failed to penetrate. Even the old Bentall made poor

work in places. The "Stubble Breaker," however, faced its task well, and so did one of the cultivators, both leaving the land in the desired ridged condition.

An extemporised implement attracted attention, *viz.*, a three-furrow tractor plough with 12-inch shares and without breasts. This faced the work well, but its failing lay in the fact that the tractor wheel ran on a breadth of the stirred surface.

It would be invidious to refer to the performance of individual machines in a demonstration that was not intended to be a strictly comparable test. Onlookers, however, could not fail to observe that there were important differences; and it was clear that, for the broad-sharing of hard-baked stubbles, there are few implements capable of making a good job. No doubt any tractor cultivator could stir the ground to the required depth if allowed to go over the land two or three times, but this would have the undesirable result of breaking up the twitch into short lengths.

* * * * * *

The Harper Adams Poultry Conference

EVIDENCE of the sustained popularity of the annual poultry conferences arranged by the Harper Adams Agricultural College was again forthcoming in the large attendance at the Tenth Annual Conference held at the College from August 10 to 12. From small beginnings these Conferences have rapidly grown into one of the most important features of the poultry year, and bring together probably a more representative gathering of poultry keepers from the four quarters of the British Isles than any other annual function. At the height of the recent Conference the attendance numbered well over 300, and a high level of interest was sustained throughout the whole of the five sessions into which the programme was divided. Each session was devoted to one, or at most two, topics, and with a view to ensuring ample time for general discussion the number of formal papers was correspondingly restricted—an arrangement which worked admirably and secured a series of discussions which, by general agreement, stamped the Conference as the most successful of the long series. In keeping with the academic environment the subjects of discussion were wholly educational, dealing with the technique and difficulties of the everyday work of the poultry farm and the bearing of the results of modern investigation thereon. Criticism flowed freely, but without heat, and the whole tone of the proceedings was stimulating and helpful.

At the opening session Dr. Crowther, Principal of the College, welcomed the visitors and gave a brief address on the "Relationship of Science to the Poultry Industry." This was followed by an interesting address from Mr. Edward Brown, the doyen of poultry educationists, on the "History of Poultry Husbandry's Claim for Recognition as a Great Agricultural Enterprise." As a very active and influential leader in all the efforts of recent years to raise the status of the poultry industry, and especially in those efforts to secure improved facilities for poultry education and research which have come so handsomely to fruition in the establishment of the National Poultry Institute, Mr. Brown's survey possessed unusual authority and interest. On the evening of the same day a very real success was achieved by Dr. Gustave F. Heuser, of Cornell University, in a lucid exposition of the judging of fowls for egg-production by means of external characters. Professor Heuser, having only recently arrived on leave in this country, had undertaken his address at very short notice, but must have felt amply repaid by the close attention with which it was followed and the enthusiastic applause and numerous questions which followed it.

The second session, on the morning of Wednesday, August 11, was devoted entirely to breeding problems. In the first half Mr. Tom Newman opened a discussion on the merits and limitations of line-breeding. He expressed the opinion that undue recourse had hitherto been made to line-breeding in the development of poultry, and that equal, if not better, results might have been obtained by more frequent, but judicious, recourse to out-crossing. A thesis so provocative naturally secured its end without difficulty in a vigorous discussion. The second half of this session was devoted to a discussion of the practical value of sex-linked inheritance crosses, the opening address being given by Mr. Marcus Slade.

From breeding, the Conference passed at the next session to housing, a discussion on this subject being initiated by Professor Willard C. Thompson, and from housing to the practical feasibility of intensive poultry keeping, of which Mrs. Charles Hunter gave a most interesting account based upon her personal experience. For the evening of the second day, arrangements had been made for the display, at the local picture house, of the Ministry of Agriculture's film of the poultry industry and most members of the Conference took the opportunity of seeing this excellent production.

The third day of the Conference opened with a discussion on the use of milk in poultry feeding, the subject being opened by

Mr. H. Howes, Assistant Director of the National Institute of Poultry Husbandry, with an address in which he gave particulars of recent favourable experience at the Institute, in the use of goat's milk in the rearing of chickens. The subsequent discussion revealed considerable interest in the subject. Catholic in its interests, the Conference next proceeded to discuss the case for the Angora rabbit, which was very ably and convincingly put by Dr. J. B. McDougall. In view of the establishment of a rabbit section in the National Institute of Poultry Husbandry at the College, the discussion proved timely and aroused much interest.

The closing session of the Conference was devoted to the question of the artificial lighting of poultry houses, Professor Willard C. Thompson dealing with the economics of the subject from the point of view of egg-production, whilst Mr. R. Borlase Matthews expounded the mechanical problems involved in the supply of electric light for this particular purpose. No little interest was also shown, during the Conference, in the inspection of the extensive new plant of the National Institute of Poultry Husbandry and in the College Poultry Laying Trials, many of the visitors being associated with the latter as competitors.

It is impossible in a cursory survey of the formal proceedings of the Conference to give a true impression of its virile and stimulative character. The enthusiasm of the poultryman for his vocation is remarkable, but never more so than when he assembles in conference. That this enthusiasm is widespread is shown by the large attendances, which, year by year, tax the accommodation at the College to its fullest capacity.

Sex-Linked Inheritance in Poultry

IN view of the interest now taken by poultry breeders in the production of first-cross birds the issue by the Ministry of Miscellaneous Publication No. 55,* "The Sex-Linked Method in Poultry Breeding," by Professor R. C. Punnett, F.R.S., will, it is hoped, prove opportune. Poultry breeders have for many years crossed two pure breeds with the object of producing good utility birds, either for table purposes or egg production, or both, but this practice was followed because it had been found by experience that these first-cross birds were usually very vigorous, quick growing, and productive. Owing to the rapid development of

* Obtainable from the Ministry; prices (post free), cartridge covers, 9d.; quarter boards, 1s. 0d.

specialisation in modern poultry keeping, however, many people desire to practise one branch of the industry only, such as egg or table poultry production, or merely the incubation of eggs and the sale of day-old chicks. In these circumstances it may be a distinct disadvantage to be compelled, with limited accommodation, to rear a large number of male birds to the age when sex can be distinguished in the ordinary way. Knowledge which enables the poultry breeder to distinguish sex with certainty on the day the chicks are hatched has a distinct value not only to the breeder, but to the vendor and purchaser of day-old chicks.

As the result of research work carried out by Professor Punnett and others at Cambridge University, certain external characters easily distinguished at birth by an ordinary observer, were found to be sex-linked. That is to say, the hens of certain breeds possessing certain kinds of plumage or shank colour, provided these hens were mated to the right type of male bird, transmit to their sons certain external characters different from those which they transmit to their daughters. The characters so inherited are three in number :—

(1) Silver ground colour of plumage and down as opposed to gold.

(2) Barred plumage, such as is found in Plymouth Rocks, as opposed to unbarred plumage.

(3) Certain forms of light shank colour as opposed to dark shank colour.

For example, if a Brown Leghorn male bird, which belongs to the gold class, is mated to a Light Sussex hen, which belongs to the silver class, the male chicks from this cross exhibit at hatching the light colour of the Sussex hen, whilst the pullets show the brown tints of the Brown Leghorn cock.

There are many other pure breeds from which first crosses showing this form of sex-linkage can be obtained. The Ministry's new publication not only indicates some of these matings, but contains two excellent coloured plates which clearly show the difference in appearance at birth of the male and female chick produced in each case. No attempt is made in the pamphlet—which is quite short, though of great interest to the breeder—to deal with all the aspects of this question from the Mendelian and genetic standpoint, but those desiring fuller information in this direction are advised to consult Professor Punnett's book " Heredity in Poultry."

MOLE DRAINAGE DEMONSTRATIONS

THE application of the tractor to the process has brought about a revived interest in mole draining. This interest became so marked that many of the County Authorities considered it desirable that demonstrations of this and other methods should be held, in order to instruct the agricultural community in the new method available, and to determine the results which could be obtained from its adoption. Accordingly the Ministry co-operated with County Authorities in arranging a series of demonstrations, each being supervised by Mr. Thompson Close. Much was done in 1924, and still more in 1925.

In an article by Mr. Close, published in this JOURNAL for July, 1925, a description of the methods and appliances available was given. It is now possible to say something of the actual effect of mole draining on the field selected for demonstration. In judging the results set out below it should, however, be remembered that a programme for a whole season had been laid down. Apart altogether from the disappointment which would have been caused to farmers coming from a distance, it was impossible to postpone a demonstration. The work had to be done on the date specified in order that the rest of the programme might be carried out. There was no opportunity of suspending the work until a more favourable occasion as is ordinarily done in farming operations. Often the weather and the conditions were so adverse that the work would not have been done at that particular time if it had not been necessary to continue the programme in some other district.

From the reports which have been collected from agricultural organizers, authorities of agricultural institutions, farmers, and others, one thing has clearly emerged : there is a general consensus, if not absolute unanimity, of opinion that tractor mole draining is effective. By far the larger majority of the reports shows that there has been a decided improvement in the condition of the fields which were mole-drained at the demonstrations. To a large extent this improvement can be attributed solely to the draining operations, but occasionally the beneficial effect has been increased by the treatment of the drained area with dressings of basic slag, lime, etc. As was to be expected, in some places the work was not so successful as in others, but some of the comparative failures can be explained by the unsuitability of the sub-soil of the land chosen for the work, and others by the unfavourable conditions under which the work was done. Sometimes the work was done in extremely

wet weather on a field that was in a very boggy condition, and where the tractor had difficulty in securing adhesion; here the results were not so good as where the surface was reasonably solid. Such comparative failures demonstrate what is in fact well known, that the best results of this or any other method of mole draining cannot be expected when weather and soil conditions are plainly unsuitable. It may, however, be said that a properly straked tractor can work on land in a condition practically impossible for horses or steam tackle, although the results may fall short of the best.

1924 Demonstrations.—Of the demonstrations carried out in 1924, those of the autumn suffered from the very wet weather of that time, since conditions frequently rendered it almost impossible to do the work properly. In the early part of the year a number of demonstrations were given in Wiltshire, Devon, and Cornwall, and were uniformly successful.

At Cullompton, Devon, a field, mole-drained not quite two years ago, was inspected in January immediately after the torrential rains of last winter. It showed no surface water, although the ground was inclined to be slushy at the side of the field where the moles were run into the ditch; but the ditch had become overgrown and the ends of the moles could not be seen. Where the main drain was clear, the moles were pouring out water at full capacity.

A field near Sherborne, Dorset, which was mole-drained in March, 1924, was examined in December, 1925. A few spots of surface water were found, although the drains were working well, but the measure of improvement effected can be gauged by the fact that during 1925 the farmer was able to graze the field with sheep, an impossibility before mole draining. The grazing, combined with the draining, has made a very great improvement in the herbage. It is now eaten down close to the ground, and there are no large patches of rough grass untouched by the stock.

In the same month, a demonstration was carried out at Bushton, Wilts. This field, which is a heavy loam, was examined in January last and compared with an adjoining field of similar type, which was not mole-drained. The latter was found to be comparatively waterlogged, while the field which had been drained was dry, except in a few small areas, where either the moles had become choked or the fall was very slight. Nevertheless all but one of the outlets were running freely. Wild white clover is now well established on this field.

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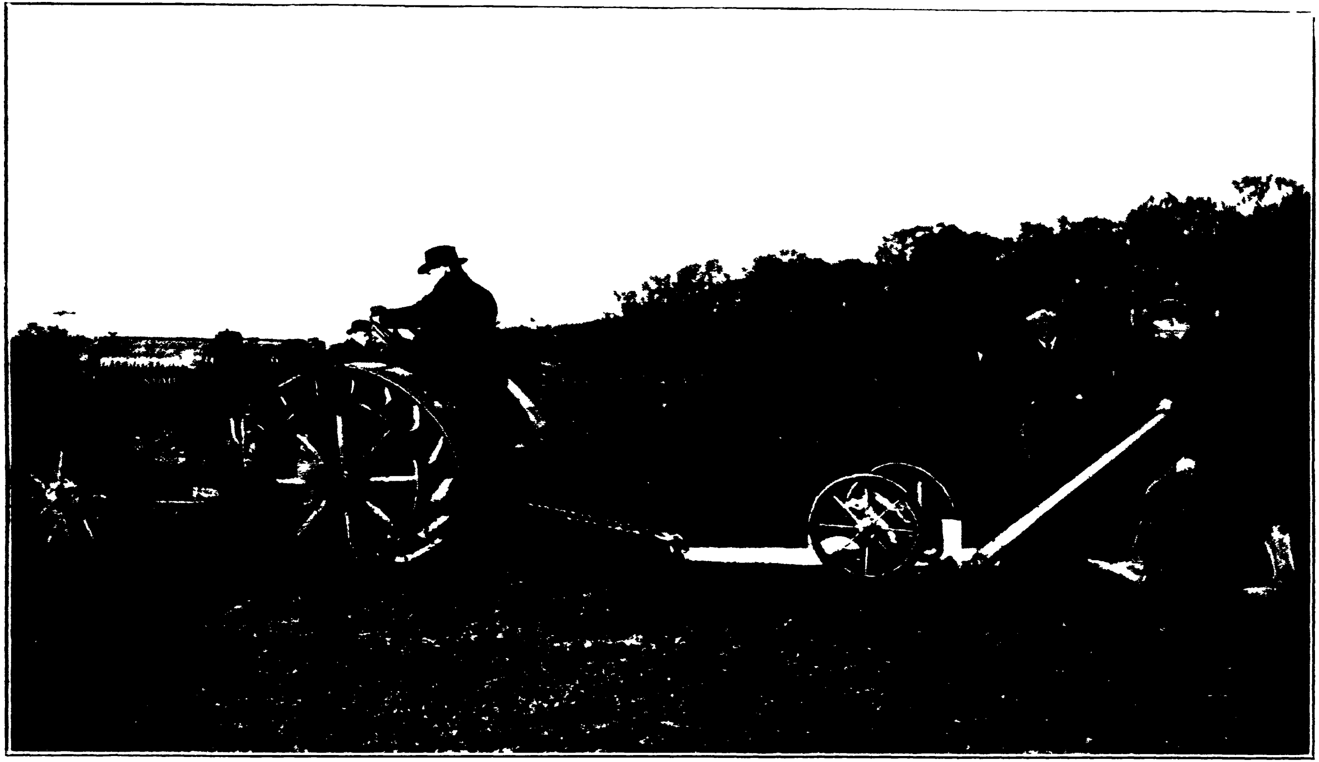
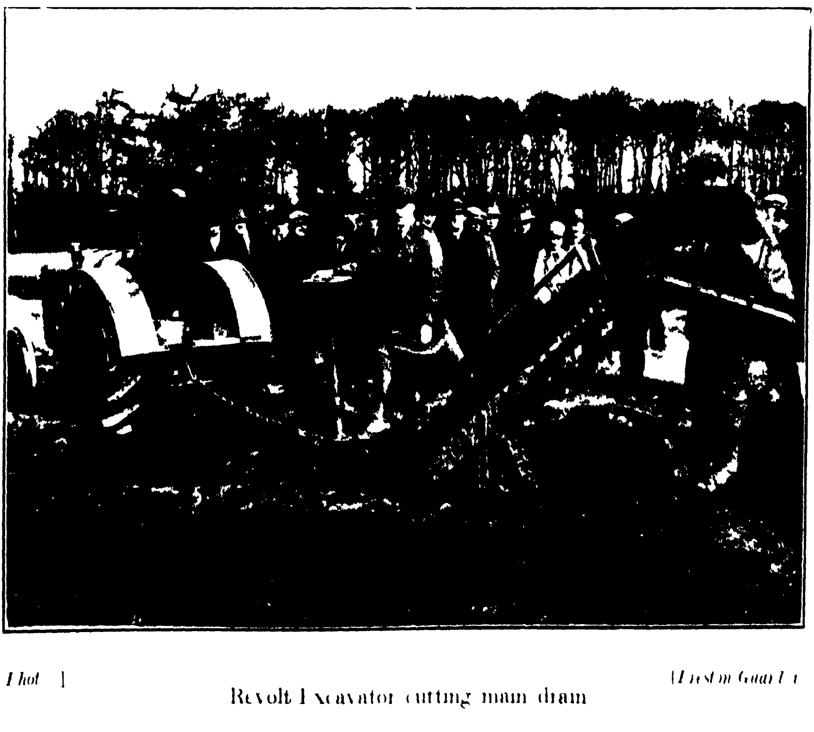
The Ransome Tractor-drawn Mole Drainer entering ground



Photo] [*Preston Guardian*

'Wells' Mole Drainer in action, hauled by an International Tractor

View of drain made by Revolt Excavator



Photo] [*Western Guardian*

Revolt Excavator cutting main drain

In the autumn of 1924 the conditions were unfavourable. In October a demonstration carried out at North Stoke, Kesteven, Lincoln, was not completed. A stubble field on heavy boulder clay had been selected which had lain very wet during the greater part of the year. The intention was to mole-drain the whole field, but the tractor employed was not sufficiently powerful to deal with the lower and more waterlogged part of the field where the surface was extremely slippery. A grass field would have provided better adhesion and even in the adverse conditions obtaining a respectable job might have been done, but the stubble gave no assistance to the tractor. Moles were, however, run on a small portion of the top of the field. Inspection early in 1926 showed that this partial draining had done little or no good.

In November, 1924, a demonstration was carried out on grass land at Brentwood, Essex. The land was spongy and the tractors cut deeply into the surface. In spite of difficulties the work was completed, and upon inspection in January last it was found that the pasture had been greatly improved. A catch pit at the bottom of the field was opened and all the moles were found to be working. Moles which infested this field have made their runs down the lines of the mole drains, without, however, interfering with their working.

These are characteristic examples of the work done in 1924.

1925 Demonstrations.—The number of demonstrations carried out during 1925 was much larger than that of 1924. The few selected examples given are indicative of the results obtained throughout the series. In the early part of the year demonstrations were carried out in the Northern Counties. At Cockle Park on the last day of January a demonstration was carried out on an old, poor pasture which had been treated with a dressing of phosphatic manure just before, and which was lying in riggs about 10 feet wide. It was quite sodden at the time of the demonstration. Part was drained every furrow and part every second furrow. On inspection in February, 1926, it was found that all the moles were working satisfactorily, and it was judged that they would last some years. The area of two acres drained at the demonstration was quite dry; but the furrows were soaked with water and many small pools were seen where no moles had been put in.

In Cumberland seventeen months after the demonstration the field which has a heavy clay sub-soil was noticeably drier. There is no sign of crumbling or breaking down of the

moles. The owner of the land is so satisfied that he has purchased a draining outfit for his own use.

During February, 1925, Northallerton was visited. The fields drained had a good natural fall, but the soil was a heavy loam with only one patch of clay. When visited in January last, after a heavy fall of rain on both the preceding days, it was possible to distinguish the difference between the drained and undrained portions of the fields by the feel underfoot, and where holes were dug in the drained portion the land was noticeably dry. It was nevertheless found that many of the moles were silted up, their diameter being much reduced in consequence. The result of this demonstration indicates, however, that some improvement may be expected from mole draining even on land where the moles cannot be expected to be permanent.

The demonstration carried out in March, 1925, at the farm of the University College of Wales, Bangor, has been comparatively unsuccessful, although the soil was boulder clay and apparently suitable for mole draining. The live moles in this field have not been so considerate as in some others, and their activities have caused some damage to the drains. Again, the spring and summer immediately following the work were very dry; consequently the coulter cuts opened up, thereby allowing loose soil to fall in and choke the drains. The only outward and visible effect of the drainage operations on this field is said to be that after heavy rain the drained portions are a little drier than the undrained.

As a result of a demonstration at Windsor, it has been possible to stock the field during the past winter at times, and in weather conditions during which this would have been impossible before draining. The herbage is distinctly improved, and there is a gradually spreading mat of clover. This is another instance where results have been sufficiently good to encourage the landowner to purchase a mole-plough.

As a final instance of successful draining may be mentioned a clay field at Purbrook, near Cosham, Hants. Although in previous rainy seasons this field has been under water, it is now sufficiently dry for the top half to be used as a playing field. In one part of the field, where the soil is silty, waterlogging persists.

Reference should be made to some instance where the work has been unsuccessful. Near Tiverton the field to be mole-drained had to be changed because the original field selected was under water. The alternative was not a happy one, since

the field was not on clay: no improvement has resulted. At Witheridge, also in Devon, the sub-soil of the field selected was largely conglomerate rock, known locally as "black ram": the continuity of the mole-drains was as a consequence broken. The drained portion of the field has remained dryer than the undrained, and the rushes seem to be reduced; the improvement could not, in the circumstances, be expected to be marked and it remains to be seen how long it will persist.

General Conclusion.—While the general result of the demonstrations, considered as experiments in mole draining, may be regarded as satisfactory, they serve also to emphasize the necessity for taking such precautions as a prudent farmer would naturally take. Good results which promise permanence can be reasonably expected only when the field is clay; with fields with a lighter sub-soil or where there are pockets of other material the improvement cannot be expected to be so great or so persistent. In many cases there may be an improvement which will repay the cost of the operation; in such instances the work can be repeated as often as is necessary. But the limits of the usefulness of the operation is a matter which must be determined by experience. Mole draining can be confidently recommended only when the field is on actual clay: but it is worth while experimenting, if this can be done at little cost, on any stiff soil in need of draining, where there is adequate fall. Wherever there are pockets or bands of lighter soil in a clay field it may be necessary for good results to use pipe drains to connect up with the moles; but pipe-draining is expensive and the extra cost may not be worth while.

On the mechanical side, the experience of these demonstrations has shown that it is useless to employ anything but an efficient and powerful tractor, and that to obtain adhesion the wheels should be well straked. Such a tractor will do good work even on very wet fields; but the best and easier work will always be done after a fairly heavy rainfall, when the surface is not sloppy and is free from water. Mole draining is impossible in dry land and the period of operation is practically limited to the months between October and April, varying, of course, with weather conditions. Even when the conditions are apparently favourable a hot, dry spell immediately succeeding will sometimes spoil good work; the cut made by the coulter will not close and the drain will silt up. Some other accidents which will lead to disappointment, such as interference by moles—rabbits have also been known to obstruct the drains—or an inefficient outfall, have been remarked above.

TRIALS OF TAR-DISTILLATE WASHES IN EAST ANGLIA IN 1926

F. R. PETHERBRIDGE, M.A.,
and
W. A. R. DILLON-WESTON, M.A.,
School of Agriculture, Cambridge.

THESE trials, which were organized in co-operation with the County Organizers, give further evidence* of the value of some of the tar-distillate washes as a satisfactory means of reducing aphides and caterpillars. Only those washes which gave good or fairly good results in the 1925 trials were tested, and in each case the makers first gave their consent to the publication of the results of the trials.

Estimation of Results.—Damage done by the various pests was estimated in the following ways :—

Aphis damage was estimated by careful observation of the number of curled leaves as compared with the total foliage.

Caterpillar damage was estimated mainly by the following methods:—

METHOD I.—The leaves were outlined on paper as if undamaged and the caterpillar damage marked. A carbon copy of these was then made. These paper copies of the leaves were then cut out (*a*) as they would have been if whole and undamaged, (*b*) as they actually were.

N.B.—The eaten areas were burnt out with hot needles. From the weights of (*a*) and (*b*) the percentage damage was determined. This method was used for the Czars at Cottenham and then abandoned for Method II.

METHOD II.—Five hundred or one thousand leaves as representative of the plot were taken from each plot by two or more observers. The areas eaten by caterpillars (this also includes a small amount of damage by other leaf feeders) were then drawn on sheets of paper. These areas were fitted together so that one large area on the paper eventually represented the holes made by a large number of caterpillars. These paper areas were then measured by means of a planimeter and thus the area of leaf eaten on the sample taken was obtained. The percentage of damaged leaves was also ascertained in some

* *See* "Trials of Tar-Distillate Washes in East Anglia." This JOURNAL, July, 1926, page 332.

cases. In addition to this laborious method, the following method was also used on the apple trees at Wisbech :—

METHOD III.—About 500 trusses of each variety on each plot were examined in May and the percentage of trusses injured by caterpillars obtained.

Experiments on Plums.—For plums a strength of 6 per cent. was used with all the washes, except in Hertfordshire, where Ialine was used at a strength of $3\frac{1}{2}$ per cent.

Cambridgeshire.—Carried out in conjunction with Mr. A. T. Paskett, Horticultural Superintendent for Cambridgeshire, in an orchard at Cottenham kindly lent by Mr. A. R. Cundle. A petrol pump was used and the spraying done by Mr. Cundle's staff under our supervision. The trees had not previously been sprayed with a tar-distillate or banded, and the branches were very green and required a lot of spray to wet them. Carbocraven covered the trees more rapidly than the other four washes, requiring only about 70 per cent. of the amount of the other washes to cover the trees properly. The results are shown in Tables I and II.

SERIES A.—Six rows of Victoria plums about 16 years old, with 10 to 14 trees in each row were used ; one row for each wash ; two or three unsprayed trees were left in each row.

SERIES B.—Four rows of Czar plums about 16 years old were used ; 6 or 7 trees were sprayed with each wash and unsprayed trees left in each row.

Hertfordshire.—Carried out in conjunction with Mr. C. E. Hudson, Vice-Principal of the Hertfordshire Institute of Agriculture, in an orchard at Holwellbury kindly lent by Mr. C. J. Dicker of Messrs Hartley & Sons, and in an orchard at Sawbridgeworth kindly lent by Messrs. Rivers & Sons. The results are shown in Tables I and II.

SERIES A at Holwellbury were sprayed by Messrs. Hartley & Sons' spraying staff. Five rows each of 24 Victoria plums about 10 years old were used ; 12 trees were sprayed with each wash and 4 plots of 6 trees and one of 12 trees were left unsprayed. All these trees were sprayed with Bordeaux Mixture and Lead Arsenate on May 12.

SERIES B at Sawbridgeworth were sprayed by Messrs. Rivers & Sons' spraying staff. Thirteen rows each of 7 Czar plums about 12 years old were used ; 2 rows were sprayed with each wash. Rows 1, 8, and 13 were left unsprayed. None of these trees was banded the previous autumn.

Huntingdon.—Carried out in conjunction with Mr. F. Tunnington, Horticultural Organizer, in an orchard at Bluntisham kindly lent by Mr. J. Searle. A hand power sprayer was used and the trees were sprayed by Mr. Tunnington. These trees were not banded the previous autumn.

SERIES A.—Five rows of Monarch, 14 years old, 10 trees in each row were used; one row for each wash and one row left unsprayed.

SERIES B.—Three rows of Victoria plums, 14 years old, of 10 trees in each row were used; one row sprayed with Carbokrimp, another with Mortegg, and another left unsprayed.

The results of the aphis damage are shown in Table I. Although there was an obvious reduction of caterpillar by some of the washes it was impossible to get figures showing their relative values, owing to the damage caused by hail.

Essex.—Carried out in conjunction with Mr. R. Hart, the Instructor in Commercial Horticulture for Essex, in an orchard at Hatfield Peverel kindly lent by Mr. W. E. Wadley. Each of the sprayed plots contained 12 trees of mixed varieties, 10 years old, Victoria, Czar, Pershore, and River's Early Prolific, and 32 trees were left unsprayed. The spraying was done by Mr. Hart, who also supplied the notes on these plots. The results are shown in Table I.

TABLE I.—SHOWING THE RELATIVE ATTACK OF LEAF-CURLING PLUM APHIS.

Place ..	Cotten-ham, Cambs.	Holwell-bury, Herts.	Saw-bridge-worth, Herts.	Bluntisham, Hunts.		Hatfield Peverel, Essex.
Sprayed ..	Jan. 28	Jan. 19 and 20 (Chafer's, Jan. 30)	Feb. 9	Jan. 26	Jan. 26	Jan. 7
Variety ..	Czar	Victoria	Czar	Victoria	Monarch	Various
Date of observation ..	April 27	April 26	May 13	April 23	April 23	May 11
Unsprayed ..	Trace—10 p.c.	25–40 p.c.	85–95 p.c.	5–40 p.c.	5–10 p.c.	Trace—Bad
Carbokrimp 6 p.c.	None—Trace	None—1 p.c.	2 p.c.	None—Trace	None	None—Trace
Mortegg 6 p.c.	None—Trace	None—Trace	Trace	None	None	None—Trace
Ialine 6 p.c...	None—Trace	—	—	—	Trace	—
Ialine 3½ p.c.	—	None—Trace	35 p.c.	—	—	—
Chafer's 6 p.c.	None	—	2 p.c.	—	..	—
Carbocraven 6 p.c.	None—2 p.c.	Trace—1 p.c.	20 p.c.	—	Trace—1 p.c.	—

TABLE II.—SHOWING THE RELATIVE DAMAGE CAUSED BY CATERPILLARS ON PLUMS.

Place	Cottenham, Cambs.				Hertfordshire			
					Holwellbury		Sawbridgeworth	
Sprayed	January 28 and 29		January 28		January 19 and 20 Chafer's, January 30		February 9	
Variety	Victoria		Czar		Victoria		Czar	
Date of observation ..	June 30		May 14		June 21		July 9	
Number of leaves ..	500		500		500		500	
	Leaves damaged	Area eaten in square centimetres	Percentage damage‡	Relative damage	Leaves damaged	Area eaten in square centimetres	Leaves damaged	Area eaten in square centimetres
Unsprayed	412	2,250	17 0	100	332	1,374	430	1,742
Carbokrimp, 6 per cent.	257	1,094	5·4	32	251	786*	350	1,174
Mortegg, 6 per cent. ..	291	1,251	10·5	62	205	644*	352	1,242
Ialine, 6 per cent. ..	295	1,304	11·3	66	—	—	—	—
Ialine, 3½ per cent. ..	—	—	—	—	276	1.226	—	—
Chafer's, 6 per cent. ..	339	1,867	12·9	76	253†	574†	—	—
Carbocraven, 6 per cent.	359	1,907	17·5	103	307	1,504	—	—

* Average of 1,500 leaves. † Sprayed on January 30 and caused 80 per cent. of the blossoms to drop. ‡ By Method I.

Results on Plums.—The above figures should serve as some indication of the value of these washes, but it must be remembered that, with two washes of equal value, the figures estimated as above would probably show differences: one wash showing the better result in some trials, and the other wash the better results in other trials.

Leaf-Curling Plum Aphis.—Tables I and II show that Carbokrimp, Mortegg, Ialine Tar-Oil Winter Wash, and Chafer's No. 1 Winter Wash at a strength of 6 per cent. were capable of controlling leaf-curling plum aphis under the varying conditions of the experiments. Carbocraven gave rather more variable results, and although in some cases it was satisfactory, this was not the case at Sawbridgeworth. The result here may be associated with its property of spreading more readily than the other washes, with the result that less spray is put on the trees. Ialine at 3½ per cent. also gave a poor control at Sawbridgeworth.

Caterpillars.—Tables I and II show that Carbokrimp, Mortegg and Ialine Tar-Oil Winter Wash at a strength of 6 per cent. were capable of reducing the damage done by the various leaf-eating caterpillars to about one-half. Chafer's No. 1 Winter Wash gave a good control at Holwellbury (here 80 per cent. of the blossom buds were injured), but not such a good control as the previously-mentioned washes at Cottenham. Carbocraven at 6 per cent. and Ialine at 3½ per cent. gave very little control of caterpillars.

Injury to Fruit Buds.—At Holwellbury, Chafer's No 1 was sprayed on January 30, as it had not arrived when the other plots were sprayed on January 19 and 20. Mr. Hudson estimated that 80 per cent. of the fruit buds were damaged by this wash. He also noted slight damage by Ialine at 3½ per cent. Chafer's No 1 at 6 per cent. and Ialine at 3½ per cent. are also recorded by Mr. Hudson as causing slight damage to the fruit buds at Sawbridgeworth. No damage was noted on any of the plots from Carbokrimp, Mortegg, or Carbocraven. Many orchards in the Eastern Counties sprayed with Carbokrimp and Mortegg have borne enormous crops this season, and some of the trees have been sprayed with these washes for three years in succession, so it appears that trees are able to withstand annual washing with some tar-distillate washes. To prevent damage, therefore, care must be taken to follow the instructions given and to use suitable water.

Effect on Growth.—As in last year's trials, so this year it was very noticeable that trees sprayed with some of these washes

produced much more luxuriant foliage than the unsprayed trees. Detailed observations on this are being made by Messrs. M. C. Vyvyan and W. A. R. Dillon-Weston.

Red Spider.—Large damson trees at Histon were sprayed with Carbokrimp, Mortegg, and Chafer's No. 1 at a strength of 7½ per cent. on January 26, six trees in each plot. No other spraying was done to these trees and on July 15 a comparison of the number of red spiders on the leaves was made. The number varied on the different parts of the trees, but we were unable to find any evidence that the spraying had reduced or increased the red spider on any of the plots. On neighbouring trees, routine-sprayed with 6 per cent. Carbokrimp, there was no evidence of reduction of red spider.

Experiments on Apples.—For apples a strength of 10 per cent. was used in the case of all the washes, as it was found last year that the trees were apparently unharmed by this strength and a big reduction of caterpillars was obtained.

Experiments in the Isle of Ely.—Carried out in conjunction with Mr. W. G. Kent, Horticultural Superintendent, Isle of Ely County Council, in an orchard at Wisbech St. Mary, kindly lent by Mr. A. Hudson. Each plot consisted of two rows of four trees and each contained two trees of the varieties Bramley's Seedling, Emneth Early, Lord Derby, and Newton Wonder. No other spraying was done throughout the season, and the trees were not previously banded. A hand power pump was used and the trees were very thoroughly sprayed by Mr. Kent, as shown by the absence of rosy aphis from the sprayed plots.

Experiments in Essex.—Carried out at Hatfield Peverel. Each plot consisted of 14 trees of mixed varieties eight years old and 28 trees were left unsprayed. The trees were thoroughly sprayed by Mr. Hart, as shown by the absence of rosy aphis from the sprayed plots. No other spraying was done throughout the season. Mr. Hart supplied the notes on aphis and helped in the picking of the leaves for the caterpillar figures.

Results on Apples.—The results of the spraying on apple trees are as follows :—

Rosy Apple Aphis (Anuraphis roseus).—Taking the two trials separately :—

WISBECH.—The trees were carefully examined on June 22, and although the control trees were marked Few, Few to

Moderate, Moderate, and Moderate to Bad, not a trace of aphis attack was seen on any of the trees sprayed with Carbokrimp, Mortegg, Ialine, or Chafer's No. 1. Carbocraven was not used in these experiments.

ESSEX.—The trees were carefully examined on May 11 and 12, and although there was a bad attack on the unsprayed trees, no trace of aphis was found on the sprayed trees (Carbokrimp and Mortegg only used in these experiments). When we visited the plots in July, there was sufficient evidence to convince the most hardened sceptic of the value of tar-distillate washes.

Caterpillars.—The results in this connexion are :—

WISBECH.—An analysis of the caterpillar population on the unsprayed trees, made with the assistance of Mr. Kent, showed nearly 20 per cent. of Winter Moth caterpillars, about 10 per cent. case-bearer caterpillars, and the remainder various kinds of Tortrix caterpillars. The proportion on the sprayed plots was also very similar. On May 12 the percentage of trusses injured was obtained, with the assistance of Messrs. W. G. Kent and J. Turnbull. These results and those obtained by Method II are shown in Table III.

ESSEX.—On July 7 a thousand leaves were taken from each plot and the damage estimated by Method II ; *see* Table III.

At Wisbech 10 per cent. Carbokrimp reduced the damage done by caterpillars to about 20 per cent. of that on the unsprayed trees. Mortegg and Ialine at 10 per cent. reduced the caterpillar damage by one-half. Chafer's No. 1 also reduced the damage to nearly one-half. In Essex 10 per cent. Carbokrimp and Mortegg reduced the caterpillar damage by one-half. The other washes were not used.

Apple Capsid Bug.—The capsid attack at Wisbech was rather variable, but a moderate attack was noticeable on most of the trees. Careful notes were taken of the intensity of the attack on all the trees, and although a slight reduction was noted on the sprayed trees, it was not sufficient to reduce the ordinary routine spraying for capsid in any way. The tar-distillate washes, which control aphides and reduce caterpillars, are useful in the control of capsid bug in that they make the ordinary contact spraying for capsids more effective by reducing the leaves curled by aphides and the shelter provided by caterpillars in spinning the leaves together. In the above experiment at Wisbech they also reduced the number of capsids slightly.

TABLE III.—SHOWING THE RELATIVE DAMAGE CAUSED BY CATERPILLARS ON APPLES.

Place	Wisbech			Wisbech			Wisbech	Essex
Variety	Bramley			Emneth Early			Lord Derby	Various
Date of observation ..	May 12	June 10		May 12	June 10		May 12	July 7
Number of leaves ..	About 500	500		About 500	500		About 500	1,000
Treatment	Percentage trusses injured	Percentage of leaves damaged	Area eaten in square centimetres	Percentage trusses injured	Percentage of leaves damaged	Area eaten in square centimetres	Percentage trusses injured	Area eaten in square centimetres
Unsprayed	82	66	1,247	78	75	1,194	83	2,557
Carbokrimp	19	33	216	26	32	189	27	1,186
Mortegg	38	60	714	52	53	549	25	1,278
Ialine	25	50	705	—	56	516	27	—
Chafer's No. 1	40	63	768	—	61	607	34	—

Apple Scab.—The Emneth Early trees all suffered from a bad attack of apple scab. The leaves picked for the estimation of caterpillar damage were examined for scab, and as seen in the following table provide evidence that Carbokrimp and Mortegg at 10 per cent. did not reduce the amount of scab.

Treatment	District	Total leaves	Leaves Scabbed
Unsprayed ..	Wisbech ..	500	388—59 doubtful
Carbokrimp ..	Wisbech ..	500	427—18 doubtful
Mortegg	Wisbech ..	500	358—33 doubtful

Effect on Growth.—At Wisbech the trees on the sprayed plots all carried much more foliage than the trees on the unsprayed plots and their appearance suggested much better prospects of a crop next year. Last year no difference was noticed in the size of the sprayed and unsprayed leaves, but this year the leaves of the sprayed trees were much larger, as shown by the following figures:—

Variety	Bramley.
Treatment	Area of 500 leaves.
Unsprayed .. .	18,692 square centimetres.
Carbokrimp	25,592 ,, ,,
Mortegg	25,682 ,, ,,
Ialine	27,316 ,, ,,

Summary.—Carbokrimp, Mortegg, Ialine Tar Oil Winter Wash, and Chafer's No. 1 Winter Wash controlled leaf-curling plum aphis at 6 per cent. and rosy apple aphis at 10 per cent.

Carbocraven at 6 per cent. reduced leaf-curling plum aphis in some cases, but failed to do so at Sawbridgeworth.

Carbokrimp, Mortegg, and Ialine at 6 per cent. reduced the caterpillars on plums to about one-half.

Carbokrimp at 10 per cent. gave a bigger reduction of caterpillars than Mortegg and Ialine at Wisbech, but gave the same results as Mortegg in the Essex trials.

Chafer's No. 1 also reduced caterpillars. Carbocraven at 6 per cent. had little effect on caterpillar damage.

Red Spider was not reduced by 7½ per cent. of Carbokrimp, Mortegg, or Chafer's No. 1.

Apple Capsid Bug was only slightly reduced by a 10 per cent. spraying of Carbokrimp, Mortegg, Ialine, and Chafer's No. 1.

Apple Scab was not reduced by Carbokrimp and Mortegg at 10 per cent.

More luxuriant growth resulted from spraying.

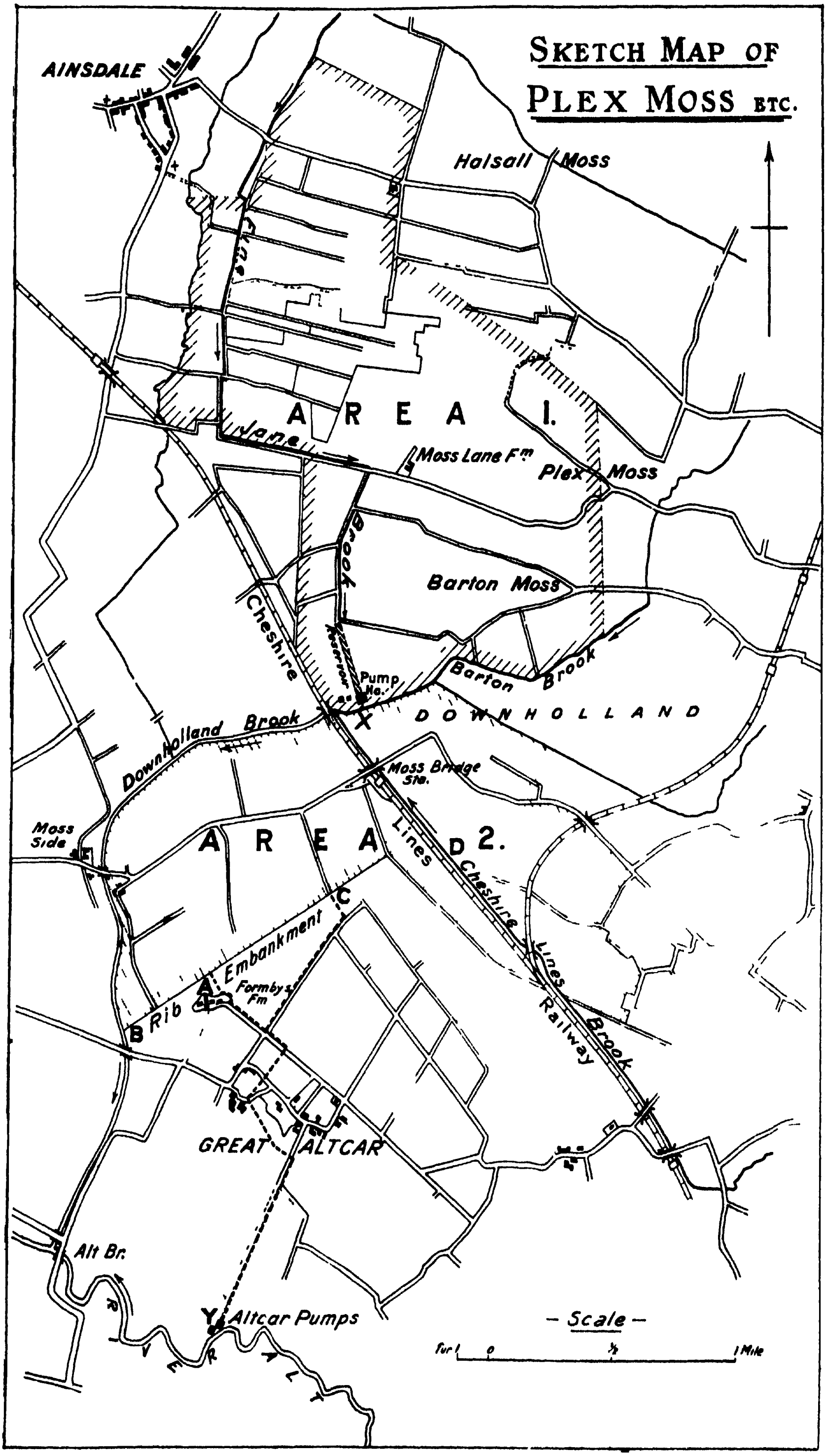
DRAINAGE OF PLEX MOSS, BARTON MOSS, AND SOUTHERN HEYES, NEAR ORMSKIRK

R. W. EATON, M.C., P.A.S.I., M.R.SAN.I.,
Engineer for the Scheme.

Plex Moss and Downholland.—The low-lying land in south-west Lancashire shown on the accompanying sketch map as Area 1 has always been liable to flood, and about forty years ago this state of affairs was much aggravated by the construction of the Cheshire Lines Railway, when water from Lydiate and other higher lands, which formerly flowed through Altcar, was diverted *viâ* the railway brook into the Downholland Brook. The river Alt, into which the Downholland Brook flows, is now the receptacle for a large percentage of the sewage and storm water from Liverpool and district; this not only adds millions of gallons to the flow in flood time, but has a tendency to silt up the bed of the river, thereby obstructing the drainage of the low land even in dry weather, and throws an extra strain on the embankments in wet weather.

For many years past the farmers have been installing pumps in this locality, almost invariably with the result that they either flooded their neighbours without doing any appreciable good to themselves or discovered that they were pumping a much larger area than their own holdings. The district is now dotted with derelict pumping plants. Matters had come to such a state that hundreds of acres of land had gone out of cultivation and tenants were giving up their farms, despite the fact that rents had been reduced and allowances made in bad seasons.

About six years ago the greater part of the Lancashire estates of the Marquis de Casteja was purchased by a syndicate of Liverpool business men, who immediately commenced to tackle the question of drainage in earnest. They commenced by cleaning four miles of the main watercourse known as "Fine Jane"; this watercourse flows between the Crossens outlet near Southport and the Barton Brook. There is so little fall in it that the water would flow towards whichever watershed happened to be the driest at the time, or whichever end of "Fine Jane" was the cleaner. They also cleaned out many other subsidiary watercourses. This work greatly improved the drainage of the land, but Plex Moss and the lands adjoining were still heavily flooded during wet periods.


SKETCH MAP OF
PLEX MOSS ETC.
AINSDALE
Halsall Moss
AREA 1.
Lane
Moss Lane Fm
Plex Moss
Brook
Barton Moss
Cheshire
Reservoir
Pump Ho.
Barton Brook
X
DOWNHOLLAND
Downholland Brook
Moss Bridge Sta.
Moss Side
AREA 2.
D
Lines
Cheshire Lines Railway
Brook
C
Embankment
Rib
A
Formby's Fm
B
GREAT ALTCAR
Alt Br.
RIVER ALT
Y
Altcar Pumps
- Scale -
Furl 0 ½ 1 Mile

The improvement resulting from the cleaning of "Fine Jane" and other ditches encouraged the new owners to invest capital in land drainage. Every advantage having been taken of gravitation, it was decided to instal a pumping station to drain the land that could not otherwise be dealt with. The chief difficulty was to find a suitable spot on which to erect the plant, as the surface of the land consists of a bed of peat about twenty feet thick, which was bound to sink when pumping operations commenced, and at any time was unsuitable for building purposes. The other large pumping stations in the district are erected on ground of a solid character and somewhat higher in level than that which they drain, but this necessitates having long conduits to the pumps to take the drainage from the distant low-lying lands. To have adopted this method would have involved the construction of a very expensive cutting and the erection of a pumping station over a mile farther up-stream from the present position. Eventually the site of the pumping station was selected (marked "X" on plan) almost in the lowest spot to be drained.

In August, 1923, building operations commenced, and although the work was often interrupted by the site being under water for weeks on end, pumping operations commenced eventually in the following August. The plant consists of two 15 in. centrifugal belt-driven pumps, each capable of discharging 6,000 gallons of water per minute against a total head of 15 ft., the power being supplied by two 66 b.h.p. cold-starting heavy oil engines; the entire plant being supplied by Messrs. Tangyes, Ltd., of Birmingham. The foundations consist of a reinforced concrete bed, weighing about 70 tons, carried on nine 12 in. square piles driven 25 ft. into the ground. The outer walls of the pumping station are carried on 11 similar piles, the inside dimensions of the building being 36 ft. by 25 ft. The engineer's cottage is of similar construction to the pump house, and is carried on 14 piles. The external walls of the pump-house and cottage are of 9 in. brick, pebble dashed. The pump well and culvert are of brick on a concrete foundation. Adjacent to the pump house is a small store built on a concrete raft; the small additional weight due to one wall being carried up a few courses higher than the opposite one caused the building to tilt 4 in. almost immediately.

As soon as pumping commenced the ground near the

pump began to dry ; and the farmers, although not enthusiastic in their praise, showed their appreciation in a most satisfactory form by commencing to till land and clean ditches which had been neglected for years. The total area at present pumped amounts to about 1,500 acres, and at a later date, if thought advisable, another 1,000 acres can be added.

The cost of fuel amounts to about 1s. per working hour per pump, including Diesel fuel oil, lubricating oil, and cleaning oil. This price should shortly be substantially reduced, as it is hoped to bring oil to the site in bulk instead of in barrel as at present.

When the pumping scheme was first considered it was realized by the landowners that the tenants could not be expected to cleanse and regrade the ditches, most of which had not been touched for years. Pumping alone would have been of little avail unless the ditches were cleaned and the water led to the pump. To solve this difficulty the owners applied to the Ministry of Agriculture in the autumn of 1923 for an unemployment grant towards the cost of cleaning the main watercourses and sufficient of the subsidiary ditches to demonstrate to the tenants the advantages to be gained thereby. Under this scheme, known as the Plex Moss and Barton Moss Unemployment Relief Scheme, thirty miles of ditches were cleaned and deepened, and a "reservoir," forming the main drain leading to the pumps, was excavated, 500 yds. long by 16 ft. wide, capable of holding 750,000 gallons of water when the pumps are not in use. This scheme employed 166 men for 22 weeks and cost £3,562.

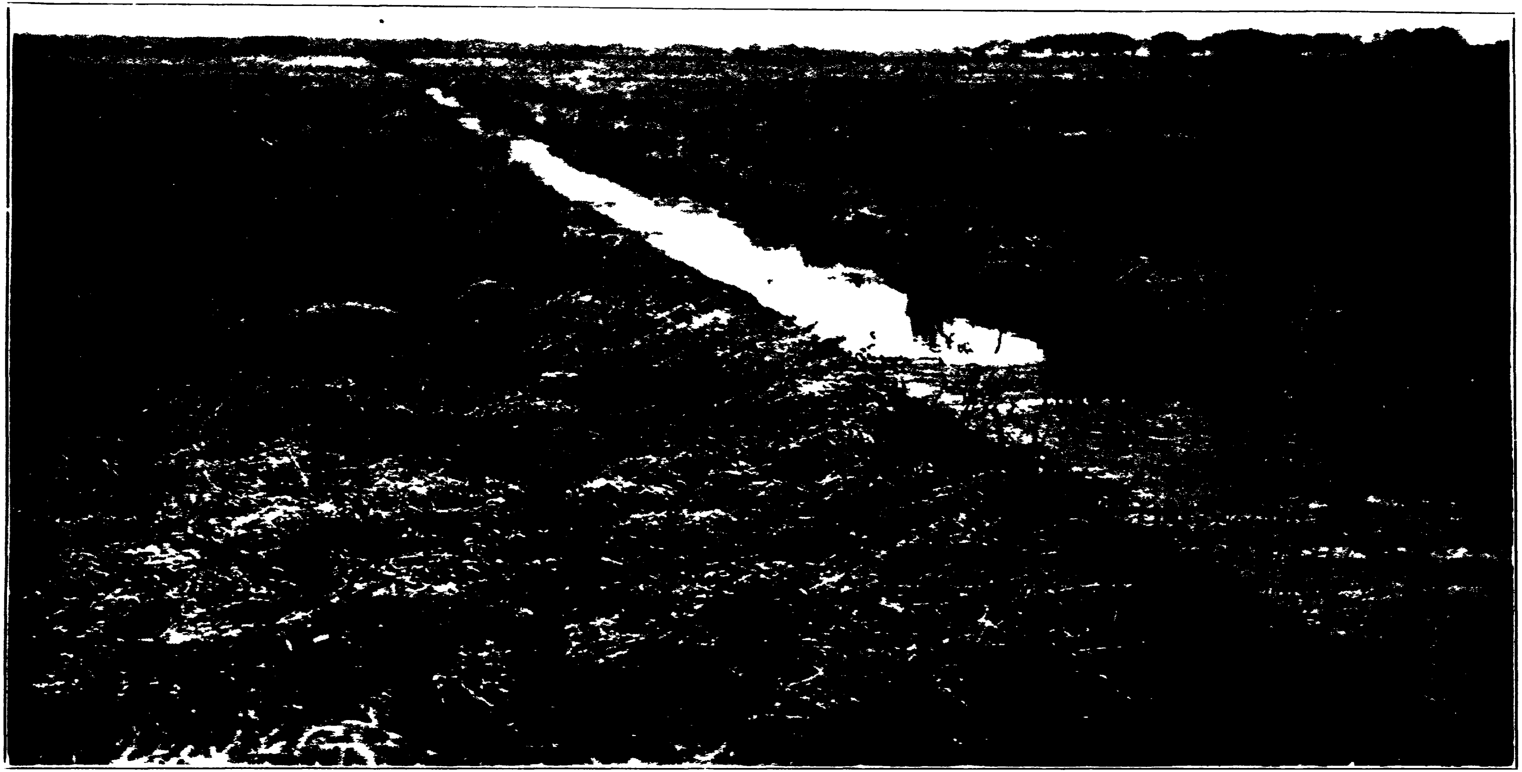
In November, 1924, a further scheme costing £1,200 was sanctioned by the Ministry, which provided for further ditch cleaning and deepening, and this was duly carried out. Since the pumps were installed over 250 acres of absolutely derelict land have been brought back into cultivation, in addition to 1,250 acres of land freed from a waterlogged condition, and there is no longer any talk of giving up farms.

Southern Heyes.—Parts of the second area shown on the sketch map were subject to flooding in wet seasons, and of late years the flooding had become worse, so serious in fact that the Earl of Sefton, owner of Altcar, had the Rib Embankment, which lies between it and this land, puddled and strengthened to prevent it bursting and flooding his estate.

To face page 601

Photo] [*Hutchinson*

Plex Moss, etc., Drainage Scheme Interior of Pump House.



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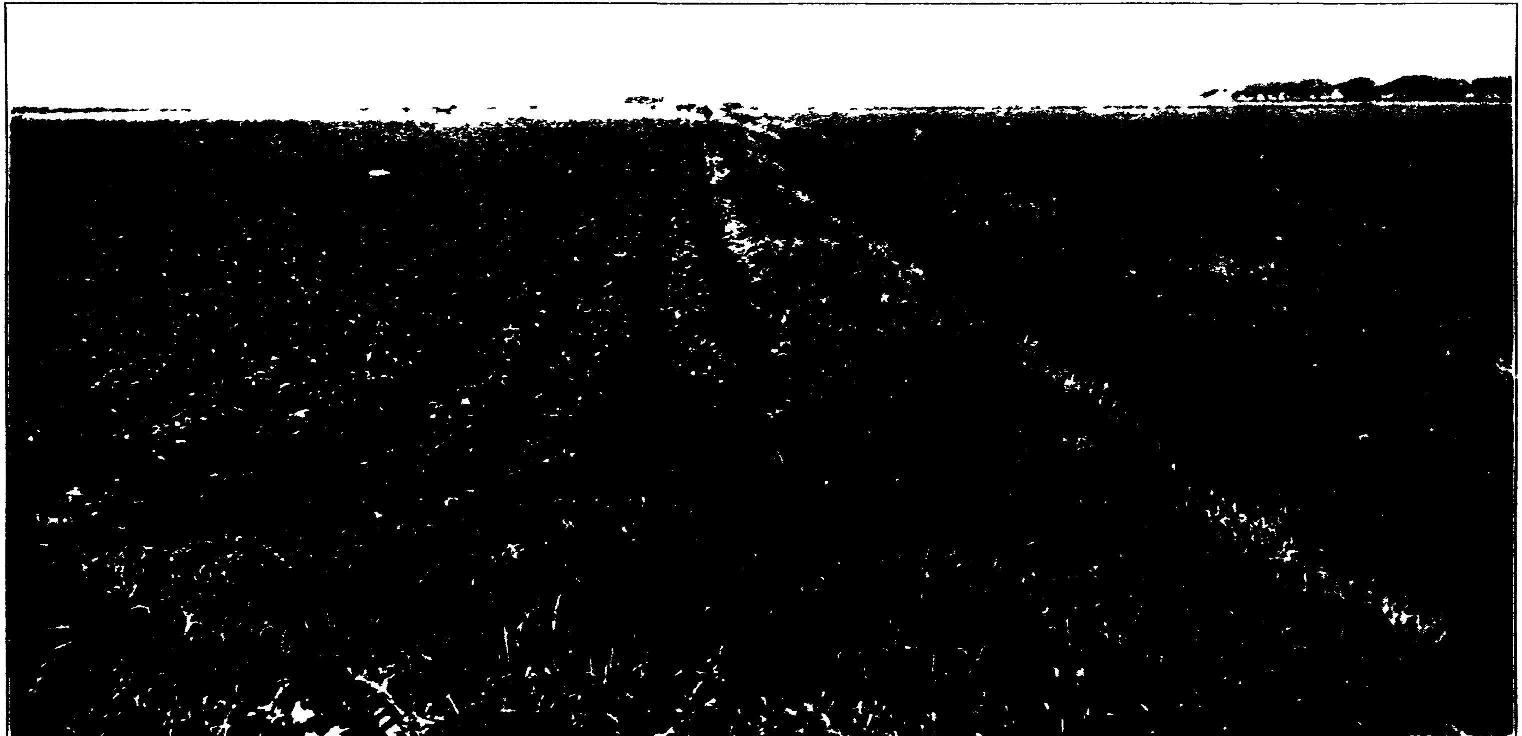
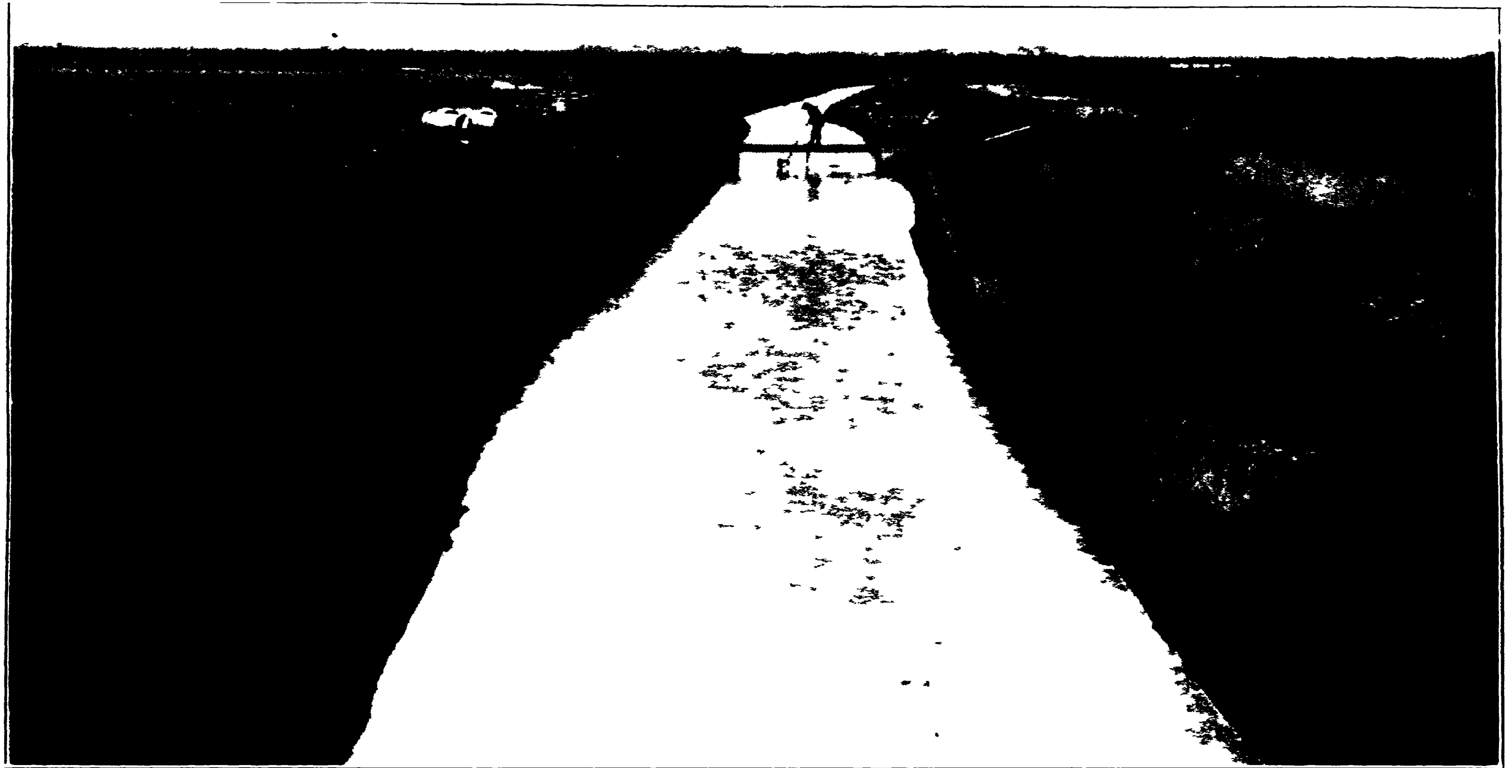


Photo] [*Hutchinson*

Plex Moss, etc., Drainage Scheme. View from same point as on opposite page, showing Land under Cultivation with Potatoes.



Pl. [illegible]

Plex Moss, etc. Drainage Scheme. Reservoir forming Main Drain leading to Pumps.

[H t In

In December, 1923, an agreement was entered into between the Earl and the owners of the Scarisbrick, Halsall, and Downholland estates to drain Area 2 to the Earl's pump, shown at point " Y " on the plan, the outlet being restricted to a 15 in. pipe at " A." The agreement, limited to a period of four months from January 1, 1924, had a two-fold object :—

(1) To allow a scheme known as the Downholland Unemployment Relief Scheme, 1923-24, to be carried out. This scheme was designed to improve watercourses on Area 2.

(2) To test the opinion that this land could be efficiently drained to the Altcar pump without inflicting damage to the lands already pumped by them.

The 15 in. pipe from the Rib was installed at the point " A." The outlet into Downholland Brook at the point " B," which was supposed to take the drainage from nearly all Area 2, was temporarily closed, as it had become defective and was allowing more water to get back on to the land when the Downholland Brook was high than it ran off in dry weather. But this outlet has since been put into order so as to act in cases of emergency. At the end of the term, the pumping having proved beneficial, it was arranged to extend the agreement, on much the same terms, for a further year to April 30, 1925, and also to instal a larger outlet at " C " in addition to the one at " A." This agreement has been again extended, and may probably become a permanent one.

The land was kept dry by means of the outlet at " A " until June 1, 1924, when the railway company's brook bank burst at the point " D," flooding the greater part of the land. From that time until the beginning of January, 1925, the rainfall was very heavy and portions of the land remained waterlogged. An action for damages was brought by one of the tenants against the railway company, which resulted in the company acknowledging liability and compensating the farmers for their loss.

The Downholland Unemployment Relief Scheme, 1923-24, previously referred to, having proved successful, schemes were promoted during the seasons of 1924-25 and 1925-26, with the result that much land has come back into cultivation and good crops have been obtained.

General Observations.—The improvement in efficiency and health of the men engaged on all the unemployment schemes was very striking. After a short time the majority again became cheerful, self-respecting, and self-supporting wage earners ; it was with regret on all sides that, when May came, their services had to be dispensed with, at a time when they were becoming skilled and the season suitable for drainage work had arrived. There were many men among them who with eighteen months' constant work would have had a commercial value in the labour market, where experienced ditch cleaners are becoming rare. There were, of course, a percentage of men who did not mean to work, a few who were out to sow discontent among their fellows, and many who were physically unfit for the work. The two former classes were soon got rid of, and many of the third category improved quickly.

The land comprised in the Areas 1 and 2 has a high rental value when dry, as it is first-rate potato ground and suitable for market-garden produce. The next step, no doubt, will be to provide some additional farmsteads and labourers' cottages, a difficult proposition at the present time. It would have been impossible to have brought about this mutual drainage scheme for the two estates had not Lord Sefton and the promoters of the pumping schemes been keenly interested in the well-being of agriculture and prepared to trust one another to carry out their bargain in a sportsmanlike manner ; but it exemplifies how much can be done in drainage, reclamation, and general development of adjoining estates if the respective parties interested combine, as they have done in this particular case.

The one regrettable feature of the work is the loss to the bird lover, as formerly this land was a haven for flocks of sea birds, wild duck, and snipe.

TULIPS

H. SOUTHWELL, A.R.C.SC.,
Ministry of Agriculture and Fisheries.

TULIPS belong to that large natural order of plants known as the *Liliaceae*. They need no pæan of praise, being exceedingly beautiful and very popular. Their hardiness and adaptability, together with the variety and delicate range of colour in the flowers, have commended them both to the grower and to the general public.

The tulip has been grown in England for several centuries, but it is not indigenous to the British Isles. Its origin is really a mystery. The crossing of varieties now extant has thrown very little light on the true wild species, while the literature on the subject lends support to the view that long before the middle of the sixteenth century the Turks grew—or perhaps cultivated and improved—the tulip in the gardens around Bagdad in much the same way as it is grown in the gardens of England to-day. With the remote possible exception of two composite wild species tulips were unknown in Mid and Western Europe before 1554. The earliest record is the dispatch of a cargo of tulip bulbs from Constantinople to a merchant in Antwerp in the year 1562. In 1571 tulips were introduced into Holland and six years later into England.

The tulip was a garden flower when it arrived in Western Europe, and it was well received in Holland. The nobility and wealthy citizens frequently sent to Constantinople for fresh supplies, while the desire to possess these Oriental novelties spread, eventually embracing the entire populace of Holland. The result was the celebrated Tulip Mania of 1634-1637. in which the desire to possess bulbs was quite subservient to the wild speculation in them, with results which have only been equalled by such great swindles as the South Sea Bubble of 1717. Since that time tulip lovers have continually searched the Near East for new varieties, and have actually found them in regions which were thought to have been thoroughly explored; while as recently as 1889 Messrs. E. H. Krelage and Sons, of Haarlem, introduced commercially the famous Darwin tulips, which, from the large number of varieties in the original stock, must have been cultivated for a long time, but their original habitat has not been disclosed.

Classification of Tulips.—Only the expert can with any degree of certainty identify varieties of tulips from bulbs, and thus the classification of tulips has its basis in the time

of flowering and the characteristics of the bloom. In reality there are just two main classes of tulips, which are separated by one month in the time of flowering. Those are the early flowering class and the May or late flowering class. Exceptions occur, for a few varieties like Le Rêve, Marie Louise, and a few others flower at an intermediate time between the two main groups, while in the early flowering section the Duc Van Thols are characterised by flowering first. Those two main groups are divided into early flowering singles, early flowering doubles, late flowering singles, and late flowering doubles. On this natural classification, however, there is superimposed another, which is mainly empirical, somewhat complicated, but in general use by gardeners.

To understand this latter classification it is necessary to be familiar with the colouring of tulip flowers and with a unique property of the tulip known as "breaking" or "rectifying." There are four sources of colour in a uniformly coloured tulip. First, there is the colour at the base—as that symmetrical portion of each petal at the bottom of the inside of the flower surrounding the ovary is called—which, with the general exception of white and yellow coloured flowers, is of a different colour from the rest of the petal. The colour of the base may be white, blue, yellow, black, etc., but in speaking of the colour of the flower, the base is not taken into account unless specially mentioned. Second, there is the colour of the tissue which lies between the two skins or epidermis of the petals, which is either white or yellow, and in white and yellow tulips is the only colour present, as the skin is colourless. This white or yellow colour is called the ground colour. Third, there is a pigment, called anthocyanin, varying through all shades of red to dark purple, which is uniformly diffused throughout the epidermis and when covering a white or a yellow ground produces all the shades of colour occurring in uniformly coloured tulips, excepting, of course, the pure white and yellow coloured flowers. Fourth, there is sometimes, but very rarely, a second pigment in the epidermis which is of a yellow colour and which gives the flower an indeterminable shade, really producing a "shot" effect.

All uniformly coloured flowers which possess the anthocyanin pigment are called "breeders" or "mother" tulips. As tulips are vegetatively reproduced by offsets, they perpetuate the characters of the parent, but at some time during the life of a "breeder" a remarkable change takes place. The flower instead of being uniformly coloured appears all variegated,

The pigment in the epidermis becomes segregated and appears as stripes and blotches on the edges of the petals, or as a broad beam of colour running up the middle of each petal, while the rest of the petal is the colour of the ground tissue. The tulip is then known as broken or rectified, and generally bears little resemblance to the breeder colour, for the pigment which was formerly diffused all over the surface of the petal is now localized and thus presents a more intense shade. As broken tulips are reproduced vegetatively by offsets, broken flowers are produced, but the pattern is liable to vary from year to year and the pigment may even spread itself again over the surface of the petals, but it never reverts to the characteristic breeder colour. It is not known when nor why tulips break, although change of soil from light to heavy coupled with a warm, dry growing season tends to produce them ; but, on the other hand, there is nothing known to prevent tulips from breaking. Other features of broken tulips are that they are not as vigorous, not as tall, nor as profuse in producing offsets as the breeder, while the foliage, which in the breeder is of a uniform green colour, becomes in a broken tulip mottled ; and this mosaic appearance remains as long as broken tulips are reproduced by offsets. Again, two breeders of the same variety may produce broken flowers which exhibit quite different patterns in their colour arrangement, and as a rule the best coloured breeders produce indifferent breaks.

Growers regard broken tulips in various ways. They call them "throwbacks," "splits," "strains," and, most erroneously and commonly, "sports." It should be understood that a broken tulip is not a new variety, and that the same variety may and does exist both as a breeder and as a broken tulip. A view is gradually gaining ground that a broken tulip is a sign of degeneration.

Pure white and pure yellow coloured flowers, which are called true selfs, breeders, and broken tulips, exist in the early flowering section, but they are not put into separate classes. The late flowering section is divided into breeders, broken tulips, cottage tulips, late double tulips, parrots, and minor classes for species and mendels.

Breeders are divided into three classes: (1) Dutch; (2) English; (3) Darwin.

(1) The *Dutch* is really the parent stock. The flower is elongated and the petals are generally pointed, but a few cup-shaped flowers do occur. The base is any shade of blue to

white. The flowers are an enormous size, but their colours are distinctly dull. Purple, maroon, and terra-cotta coloured flowers are the most prevalent. They show all shades of purple to violet on a white ground (called bybloems), all shades of scarlet to brown on a yellow ground (called bizarres).

(2) The *English Tulip* was selected from the Dutch stock by the tulip lover during the nineteenth century. It is a tulip of outstanding merit. The flower is shaped like a true cup, resembling half a ball. The colours are clearer and brighter than the Dutch breeders, and the base is either a pure white or a dazzling yellow. They show all shades of pink to rose on a white ground (called roses), all shades of purple to violet on a white ground (called bybloems), and all shades of scarlet to brown on a yellow ground (called bizarres). In the broken state two types are recognized—the feathered, in which the colour is in the form of a fine pencil work on the edges of the petals; and the flamed, in which, in addition to the feathered edge, there is a branching beam of colour up the centre of each petal which unites with the feathered edge. They are rarely grown now except by the tulip fancier.

(3) *Darwin Tulips.*—These are a race of breeder tulips. They are tall, very vigorous May-flowering tulips of bright colours. The flower stalk is long and distinctly strong. The flower has a characteristic shape. It is a cup-shaped shallow flower. The petals are never pointed. The base is any shade of dark blue to white, but never yellow. The yellow ground colour never existed in Darwins; thus they consist of roses and bybloems.

Rembrandt Tulips.—These are broken Darwins. Darwins as a rule never make clean breaks: instead of all the colouring matter becoming localized in one part of the petal, a little is usually left diffused throughout the epidermis. Thus Rembrandts generally show two shades of colour upon a white ground.

Cottage Tulips.—These are a heterogeneous collection. During the labours of the British florist to select the English tulip a large number of varieties were rejected because as breeders they did not reach the required standard and as broken varieties were worthless. They thus became relegated to cottage gardens, and have since been re-collected and added to with tulips which have had a similar history on the Continent. The class includes the late flowering breeders and broken tulips which do not fall into the classes mentioned above, the true selfs, and also the whites and yellows which

have a narrow edge of red colour on the petals, as well as the "shot" tulips. The shape of the flower varies immensely. There is the egg-shaped form, as in John Ruskin and Innocence; the cup-shaped form, as in Bouton D'Or and Inglescombe Yellow; the pointed form with a distinct waist, as in Mrs. Moon and Walter T. Ware; and the form having recurved petals, as in Retroflexa and Elegans.

Late Double Tulips.—These tulips simply have a double perianth.

Parrot Tulips.—These are a very old type, having fantastically cut and lacinated petals, which are grotesquely marked with brilliant yellow and scarlet colours. They are nearly all bizarres and are somewhat shy of flowering. Their place is in the garden.

Species of Tulips.—This class is also known under the name of Botanical tulips. It includes those tulips which have been found growing wild in Central Asia, etc., and have the property of breeding true from seed. They are somewhat rare and are only grown in the garden.

Mendel Tulips.—Of recent years a good deal of work has been done in crossing early flowering varieties of tulips with Darwins, the idea being to combine earliness with the quality of the Darwins. Such tulips are now being classed together under the name of Mendel tulips. It is too soon yet to form any reliable estimate of their value for the commercial grower, but some appear to be promising.

Nomenclature and Synonyms.—As might be expected the nomenclature of tulips bristles with difficulties. The same variety may have been re-christened several times, while the same name has been applied to two different varieties. Mrs. Potter Palmer, a Darwin tulip, has been renamed twice, first into Fashion, then to D. T. Fish, and is known by any of those names. But there is a variety called Fashion in the Cottage class, and this variety has received the additional name of Perle Royale. Hobbema, American Lac, Le Rêve, and Sarah Bernhardt are one and the same variety. This chaos has no doubt arisen partly through the ignorance of an introducer of the previous existence of the variety, partly through regarding broken varieties as new ones, and partly through the deliberate renaming of varieties already known. In 1914 the Royal Horticultural Society took up the nomenclature of tulips, and grew practically every variety in its gardens at Wisley. A committee of experts

eventually published a valuable report dealing with synonyms in tulips, and since that time the leading bulb merchants have listed synonymous varieties in their catalogues.

Lifting and Treatment of Bulbs.—Tulip bulbs in the field are ready for lifting late in June or early in July, when by merely handling the dead foliage it comes away from the crown of the bulb. When this stage is reached maturing or ripening of the bulbs is nearly completed. Bulbs are lifted by the fork, or more commonly by the plough, and are placed in trays, which are stacked one above the other in the open air so as to dry. During the process care is taken to keep varieties separate. If climatic conditions are not suitable for quick drying, the trays of bulbs are removed and placed in a semi-dark store, where if necessary heat can be applied to hasten drying. The bulb grower, in contrast to the flower grower, always adopts this latter course. Ripening and drying of bulbs is a very critical phase in the life history of the tulip and must be completed at once; thus bulb growers in this country welcome a drought at this time of the year. Correct ripening and drying of bulbs mean greater stamina, longer flower stalks, enhanced colours, and more flowers. Delayed harvesting results in the absence of the protective skin on the bulbs, unevenness in flowering, and a lack of vitality. Very bright light, especially sunlight, should never be permitted to reach bulbs. After the bulbs are dried they are riddled gently so as to clean them, and at the same time offsets are removed and the bulbs sometimes graded into first, second, and third sizes, and small non-flowering bulbs. The last-named pass under the names of "seed," "dibs," "spawn," "brood," etc. Leading bulb growers, however, grade their bulbs by hand on the basis of weight per thousand.

The subsequent treatment of bulbs depends on the object in view. During the warm summer months the flower bud in the bulb is developing and growing, but after a certain stage is reached its continued growth is dependent upon the gradual fall in temperature. Bulbs which are to be forced for early flowering are stored in a warm dark shed until the middle of August, by which time the optimum conditions for the further growth of the flower bud involve a gradual fall in temperature. The bulbs are then removed to a cooler place—where possible, steps are taken to reduce the temperature gradually—and are left in that store until planting time. Bulbs which are intended to flower at their normal

time are left in the dark store at ordinary atmospheric temperature until planting time. It is possible now to delay the flowering of tulips and thus arrange for a succession of bloom in the garden or for the market. This is brought about by reversing the optimum conditions for the continued growth of the flowering bud during the months of September and October, thus inhibiting its growth. To retard the flowering of tulips, batches of any one variety of bulb are heated in a dark store to a temperature of 60° F. to 65° F., maintained day and night, for a period of from three to seven weeks, commencing the first week in September. They are then placed in a cool store and planted late in November and in December. The delay in flowering is proportional to the length of the heat treatment. Bulbs heated for seven weeks may be one month later in flowering than untreated bulbs of the same variety, but it should be remembered that climatic conditions about flowering time may be so favourable for the production of bloom as to reduce that time considerably.

This process of delaying flowering is still in its infancy, and in some varieties factors are present which, not being thoroughly understood, give indifferent results; but success is assured with certain popular commercial varieties, providing the bulbs are not less than a certain weight, which really means providing the bulbs possess a developing flower in the bulb, for, in each case, top-sized heavy bulbs will weigh nearly twice the amount. These well-known commercial varieties are Farncombe Sanders, weighing not less than 40 lb. per 1,000; Inglescombe Yellow, Clara Butt, Macrosphila, Parisian White, and Wm. Pitt, each weighing not less than 30 lb. per 1,000. This heat treatment of bulbs in September and October has other effects. It improves the colour of the flower and, by delaying flowering, increases the vegetative period during which bulbs grow; and it has too the somewhat doubtful advantage, depending on whether the variety is naturally prolific or not, of stimulating the formation of offsets.

Usually it is necessary for a grower to buy or sell tulip bulbs, and leading growers buy bulbs on weight, not size. A bulb really consists of reserve food material for the plant it will produce, and this food material is stored in the rings or flesh of the bulb. As bulbs modify their size and general characteristics according to the environment in which they have been grown, large bulbs may have no more rings or flesh than the smaller bulbs, the increase in size being due to water,

which bulbs naturally store up greedily. The small, heavy, tight bulb responds more readily to forcing and is more resistant to disease than the large flabby bulb, and it produces a tough, harder bloom with more lasting qualities than that produced from the larger and more watery bulb. Further, a forcing house which will hold 45,000 large bulbs will hold 60,000 smaller and heavier bulbs, which yield more flowers in a given time and of a better quality than can be produced from the large flabby bulb, and this same principle holds good in the field.

The following example may illustrate the method of buying or selling tulip bulbs. If 1,000 bulbs of the variety Clara Butt, weighing 45 lb., are worth 42s., then 1,000 Clara Butt bulbs, weighing 35 lb., are worth 35/45ths of 42s.=32s. 8d., and so on. The lower the price paid per 1,000 bulbs the greater the reduction in the quality of the flowers and the irregularity of flowering; and on this basis full value for money is always obtained. But in buying bulbs by weight it is necessary to bear certain facts in mind. The bulbs forming the consignment should be of equal weights and they should be clean (one does not usually buy soil at bulb price). The weight too of 1,000 bulbs of different varieties of the same quality varies; for example, 1,000 bulbs of the variety Clara Butt, weighing 42 lb., are about equal in quality to 1,000 Farncombe Sanders bulbs weighing 70 lb., and as might be expected supply and demand govern the price. Also tulip bulbs from about the middle of August to early in November lose weight. Flowering tulip bulbs, varying with the variety and the soil in which they are grown, lose at least 1 lb. per 1,000 per week; but as a general rule tulip bulbs are bought, sold, and delivered before the end of August, and are then stored according to the object of the grower. A grower too when buying bulbs must also take into consideration his peculiar requirements. If flowers are the primary object he will buy the heaviest bulbs; if the object is to increase the stock he will buy the small non-flowering bulbs.

Propagation and the Raising of New Varieties.—The raising of new varieties of tulips is brought about by two methods: (1) by seed; (2) the spasmodic appearance of sports. The method of raising new varieties by seed consists in crossing two varieties. It is a long and tedious business and is only handled efficiently by the expert. It may be dismissed here by stating that seedlings of garden tulips do not resemble

their parents in all their characters, whether the parents are breeders, or broken tulips, or one of each, the resulting tulip will be uniformly coloured, either a breeder or a true self. Sports appear in tulips for some unknown reason, and as the characters of the plant, including the flower, also the colour of the latter, are permanent and different from its parent it is a new variety.

Tulips are propagated vegetatively by offsets, which are produced naturally during the growing season. The tulip bulb planted in autumn is not the same bulb as that lifted in June. When a flowering tulip bulb is planted the bulb not only contains a developing flower bud with its stalk, but also another bud which arises from the base of the bulb just above the origin of the stalk of the flowering bud. During the growing season all the food material in the planted bulb is used up and the bulb disappears, but the bud grows into a bulb and

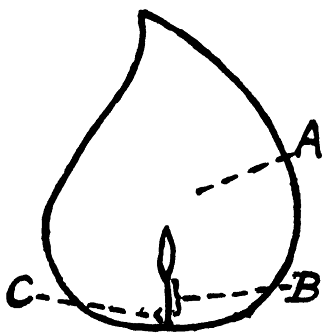


FIG. 1.

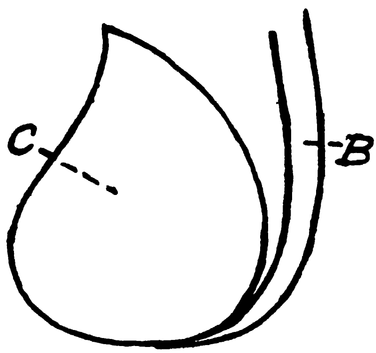


FIG. 2

A. Planted Bulb which disappears during growing season.

B. Flower Stalk arising from the base of C, *i.e.*, the bud in Fig. 1 and the lifted bulb in Fig. 2.

takes the place of the planted bulb, with the result that on lifting, the flower stalk is attached to, and appears to spring from, the base of the lifted bulb. Sometimes there are two or more buds in the planted bulb, and each bud may grow into a bulb, with the result that the flower stalk then appears to spring from the basal centre of a bunch of bulbs. The accompanying diagrams may illustrate this.

The capacity of any variety of tulip bulb for yielding offsets is mainly determined by the size and weight of the planted bulb and its natural ability to increase in weight under the conditions in which it is grown. Clara Butt grown in the field under conditions most suitable for the production of flowers for market will increase in weight up to 75 per cent.,

providing the foliage is not ruthlessly destroyed. If the planted bulb was large and correspondingly heavy there will be lifted, on an average, five flowering bulbs and four to six non-flowering bulbs for every bulb planted. Of the flowering bulbs two will be of forcing quality and the other three, known as "planters," will yield flowers of average quality if grown in the field. If the planted bulbs were of second quality, *i.e.*, weighing about 35 lb. per 1,000, then for every bulb planted there will be lifted on an average three flowering bulbs and very few non-flowering bulbs. Of the flowering bulbs two will be forcers and the other a planter. Farncombe Sanders grown for flower production will increase up to 25 per cent. in weight. If the planted bulbs were large and heavy there will be lifted on the average two bulbs for each bulb planted. Pink Beauty and White Beauty give no increase in weight when grown for flower production, and any increase in the number of bulbs at lifting time will be small non-flowering bulbs. There may even be a loss in weight due in part to the very small offsets being left in the field. Those examples are illustrative of the capacity of tulips to reproduce themselves vegetatively when grown for flower production. As might be expected the common commercial varieties increase most in weight and are naturally prolific. In general they yield results which fall somewhere between the examples of Clara Butt and Farncombe Sanders cited above.

During the first week in August bulb and flower growers weigh the quantity of bulbs necessary to plant an acre of ground, and at the same period in the following year, *i.e.*, when the bulbs are under the same conditions, the produce is weighed. The increase in weight, estimated at the current market price, plus any profit obtained from selling flowers from the same acre of bulbs, indicates the prosperity or otherwise of the business.

Raising Flowering Bulbs.—The method of raising flowering tulip bulbs from small non-flowering bulbs consists in growing the bulbs for one or more years and assisting, as far as is possible, the work of the leaves and roots of the plant in building up flowering bulbs, and at the same time eliminating any factors which are calculated to have the opposite effect. The growth of the bulb depends upon the activity of the leaves and roots during the growing season. Small non-flowering bulbs are kept in a dark store at a temperature of about 55° F. until planting time. The effect of this temperature during late August

and September is to delay maturity, thus lengthening the vegetative growing season during which bulbs grow. Tulips prefer a well-drained light loam to which manure has not recently been added and which did not grow tulips the previous season. They thus follow a crop like potatoes or hyacinths. The furrow is made by the plough, the rows spaced 8 in. apart, and after every seventh or eighth row a space of 1 ft. is left for a path. The bulbs are planted the depth and distance of a bulb apart during September. In spring a top dressing of ammonium nitrate is applied to encourage the growth of the foliage. Beyond keeping the beds free from weeds tulips require very little attention, but during weeding care should be taken not to damage the foliage.

Flowering is a very expensive process in the life of a tulip and it seriously reduces the quality of the growing bulbs. If any flowers appear they are removed, but the green flower stalk is left to assist the leaves in their work. For the same reason, when there is a glut of tulip flowers on the market and more in the field ready to be picked, flower growers remove the flower but not the green flower stalk, thus reducing financial loss by increasing the weight of the bulbs. After the foliage dies down the bulbs are lifted and dried. If the bulbs are now flowering bulbs they are stored or sold and then treated according to the object of the flower grower. If the bulbs are still non-flowering or a third-rate flowering bulb this process is repeated so as to produce a first-grade flowering bulb. The nature of the soil in which bulbs are grown together with the water content of that soil influence the size of the lifted bulbs. If the soil is a light sand with a subsoil plentifully supplied with water, then the inherent capacity of tulip bulbs to store up water is given full scope and the lifted bulbs will be large in proportion to the number of rings forming the bulb. If the soil is heavier and not so plentifully supplied with water the bulbs will be small.

Forcing Tulips.—The ordinary life cycle of the tulip is that bulbs are planted early in October just when the soil begins to lose heat and gain water, and during the cold, dark, and wet winter months the planted bulbs begin and continue to grow. Roots are produced early in November, and in January leaves appear above the soil, while the flowering bud keeps pace with the growth of the foliage. But after the flowering bud has reached a certain stage, the optimum conditions for the completion of flowering involve primarily a

rise in temperature. A few warm days and nights in spring provide the necessary stimulus for the flowering of the plant. In forcing tulips into flower, conditions resembling the above have to be brought about artificially. From the life cycle it will be apparent that bulbs grown in a warm climate or in a well-sheltered district may at planting time be further advanced, and in the forcing house would probably flower earlier than bulbs grown in colder and more exposed climates. Not only that but the soil in which the bulbs were grown influences to some extent the time of flowering. Thus bulb forcers select heavy, well-matured bulbs which have been grown in one district or in one particular field, and which have been subjected to similar treatment since they were lifted, so as to ensure evenness in flowering in the forcing house. To plant, in the same box, bulbs which have come from different sources and from different soils, and which may have had different treatment during the summer months, results in irregular flowering in the forcing house and consequent increase in the cost of production.

Forcing Early Tulips.—A light virgin loam is the best soil to use for forcing tulips, but if that cannot be obtained then a loam in which tulips have not been grown for several seasons may be used. Some growers select the soil for forcing tulips early in the year and dig it over well. It is then watered and afterwards covered with straw or some other covering material so as to prevent the light and heat of the summer months from entering it. When bulbs which have undergone preparatory treatment during the summer months are planted in such soil, conditions resembling mid-winter are present and the bulbs begin to grow at once.

There are no standard-sized boxes for forcing tulips, but boxes 12-18 in. wide, 18-24 in. long, and 5-6 in. deep are suitable. Before filling with soil, the boxes, especially new ones, are soaked in water so that they will not absorb water from the soil. Tulips are sometimes forced in pots, but pots are not as economical in space as boxes; when used they are first thoroughly cleaned and then soaked in water. Scientific experiments have conclusively proved and explained what is the common practice with the bulb forcer, *viz.*, that the addition of a phosphate to the soil hastens maturity. Before flowering tulip bulbs can mature they must flower, and fine bone meal is the form of phosphate which should be added liberally to the soil in which tulips are to be forced. A layer of

well-rotted farmyard manure is generally put in the bottom of the box, as, during the heat under which the bulbs are forced, the manure, besides supplying nutriment to the plant, retains water longer than soil, and thus prevents the drying up of roots.

Varieties of early tulips (suitable varieties are stated below) which are required to flower before the middle of January are planted in boxes during late August or early September, but varieties of early tulips which are required to flower later than the middle of January will give better results if they are not planted until late in October or early in November. The boxes are filled with the chosen soil, which is well watered, and the prepared bulbs are planted 1 in. apart, their necks being covered to a depth of ½ in. The distance apart is not a hard-and-fast rule, but varies with the size of the bulb. Immediately after planting follows the process of digging-in. Previously a well-shaded spot has been selected, and the soil, which has not been used for the same process for some years, is dug and well watered. Digging-in consists in placing the boxes of tulip bulbs on a layer of this damp soil and heaping more soil up the sides of the boxes. Cinders, sand, or soil is then placed on the top of the boxes to a depth of 4 in. and finally a layer of damp soil. The boxes are thus completely hidden from view and are left there until ready for the hot-house. Under these uniform wintry conditions roots are formed and stimulated into action, and the success of forcing tulips depends largely on the amount and activity of the roots. Three weeks before the bulbs are required to flower the boxes are put—after shaking off the top layers of soil, cinders, or sand—into a heavily shaded hothouse which is at a temperature of 60° F., which after five days is gradually raised to 70° F. The rate and height to which the temperature is raised is regulated by the reaction of the plants, and as the temperature is raised the supply of water and air is correspondingly increased. Careful and efficient ventilation as well as watering are prime requisites. The soil must not be permitted to get dry. Oscillations in temperature are fatal; the heat must be kept up day and night. If it is necessary to rush the bulbs into flower it should be done towards the end of the forcing period and not at the beginning. When the flower stalk and bud are well advanced the bulbs are removed to a light greenhouse which is at a temperature of 65° F. There the foliage and flower stalk take on their characteristic green colour and the flower opens. In general tulips do not force

well with heat from below. The heat is required to stimulate the growth of the foliage and flower, while the roots to perform their essential work efficiently require to be kept comparatively cool.

Three weeks are required in the hothouse to force early varieties into flower, but some varieties such as the Duc Van Thols and Proserpine may be forced into flower in fourteen to sixteen days. The following varieties may be forced into flower by Christmas: all the Duc Van Thols, Diana, L'Espérance, King of the Yellows, Mon Trésor, Rose Precose, Brilliant Star, Proserpine, and Le Matalas. The following may be had in flower during the first week of January· Salvator Rose, Thomas Moore, Fred Moore, Prince of Austria, Tournesall, and Tournesall Yellow. The following may be had in flower during the middle of January: Flamingo, La Reine, Maxima, King of the Yellows, Rose La Reine, Yellow Prince, Hobbema, Herman Schlegel, and Couronne D'Or. After the middle of January any early variety may be forced into flower, but choice kinds include the Hawk varieties (*i.e.*, Red and White Hawk), Imperator Rubrorum, Vuurbaak, Rubia Maxima, and Couleur Cardinal. Early varieties of bulbs which have been forced are of no further commercial use and are discarded.

Forcing Darwin Tulips.—Practically all the May-flowering tulips have very long flower stalks, but as the Darwin strain is a very vigorous stock and yields attractive popular flowers it is chosen for forcing. Even with the Darwins it is necessary in forcing to proceed carefully; otherwise the bulbs may not flower, or if they do the flower stalk may be so weak as not to stand upright. In forcing Darwin tulips the same course is followed in regard to soil, manures, and digging-in as in forcing earlies except that the bulbs are planted 2 in. apart and the boxes are not less than 6 in. deep. Heavy bulbs, which have undergone preparatory treatment during the preceding months, are boxed in September and October. The boxes are brought into a light greenhouse one month before the flowers are required. The heat is overhead and the temperature is gradually raised to 55° F. Like the first earlies, the rate at which the temperature is raised is governed by the response in the growth of the plants, and as the temperature is raised ventilation and water are correspondingly increased. Oscillations in temperature are not allowed; thus as the plants are in a lighted greenhouse, they must be shaded from direct rays of the sun, which may be strong during the month when such

tulips are being forced into flower. Side sprouts, too, must be immediately removed to conserve the energy of the plant and draft it into the desired channel. Wm. Pitt, Wm. Copeland, and Bartigon are the three varieties which stand heat better than the other Darwins, and on introduction to the hothouse may be shaded until the flowering stem is about 6 in. high. The temperature, too, may be raised as high as 75° F.

Not all varieties of Darwin tulips can be forced into flower at the same time. Wm. Copeland may be got into flower easily by the first week in January, and Wm. Pitt and Bartigon by the end of January. The following may be forced into flower by the middle of February — Frank Hals, King Harold, Homère, Victoire D'Oliviers, and Phillip De Commines; after the middle of February— Centenaire, Farncombe Sanders, Princess Elizabeth, and Prof. Rauwenhoff. Varieties like Pride of Haarlem, Rev. Ewbank, Clara Butt, etc., are not easily forced with satisfactory results, but when boxed up at the end of December and brought into the greenhouse at the end of February are generally a success.

Cultivation in the Field.—Tulips for the market are also grown in the field. A well-drained light soil, which has not grown tulips the previous season, and to which no manure has recently been added, suits them admirably. Apart from the liability to introduce the disease called "Fire," tulips do not flourish on the same soil two consecutive years. They usually follow a crop which has been heavily manured, such as potatoes or hyacinths. Tulips love water, but stagnant water is inimical to them; thus a well-drained soil is essential for their well-being. Bulbs are planted at varying times between October and Christmas. The untreated bulbs are planted first, and the treated bulbs at intervals, varying with the length of the heat treatment, those having received the longest heat treatment being planted last. The plough is used in making the furrow, and fine bone meal at the rate of 5 cwt. per acre is put in those drills which will subsequently be planted with untreated tulip bulbs. The furrows are 8 in. apart, and after every sixth or seventh row, 14 in. is left as a path. The bulbs are planted 4 in. deep and 3½ in. apart. Thus tulip bulbs are planted, except for depth and distance apart, in the same manner as potatoes. After planting, apart from frequent hoeing to keep down weeds, they require little

attention. When using the hoe, care must be taken not to damage the foliage, particularly in the case of the basal leaves, as they provide most of the nourishment for the growing bulbs. As varieties are planted together, rogues, sports, and broken varieties are staked at the time of flowering, and the bulbs removed from the stock at the time of lifting. There are numerous varieties of tulips grown in the field for marketable flowers. Selections are made from Darwins, Cottage Tulips, Rembrandts, etc. Some of the commonest are Clara Butt, Loveliness. White Swan, Pride of Haarlem, Mrs. Moon, Inglescombe Yellow, Wm. Copeland, Wm. Pitt, Farncombe Sanders, Murillo, etc.

Packing and Grading of Flowers for the Market.—The art of packing flowers for the market is to ensure that the bloom comes out of the box after transport as fresh as when it was put in; the attractiveness of the bloom when placed before the ultimate owner having a large influence on the amount he is willing to pay for it. Growers endeavour to collect their bloom so that it will be at its best, not when picked, or when in the hands of the wholesaler or retailer, but when it reaches the ultimate purchaser.

The exact state of maturity at which bloom should be picked varies with different varieties of tulips, and also with the length of time likely to elapse before the flowers reach the ultimate owner, and thus must be left to the judgment and experience of the grower. The preservation of tulips in transit from grower to consumer is largely a question of the amount of water in the bloom and the rate at which it is lost. Flowers are accordingly picked early in the morning or towards dusk, for at those times the water content of the flowers is greater than at any other time of the day. After picking, the flowers are transferred to a clean, cool, semi-dark roomy packing shed where plenty of water is available. They are placed in buckets of fresh water for several hours or overnight, so as to ensure that the veins are full of water, and that the flowers will have something to feed on until they receive water again. To prevent the setting up of fermentation and heat, with resulting decay of both stalk and bloom during transit, the flowers are allowed to drain after removal from the water. Some growers gather their tulips, grade and box them without putting them in water. Whether that method can be used successfully depends on the condition of the flowers, and also on the time taken in reaching the ultimate owner, but, in

general, it is not a course to be recommended. Tulips are graded into "specials," "best," and "second best," and the quality in any grade is kept as uniform as possible. Flowers of the same variety, same age, and with the same length of stalk are bunched together. The number of flowers in a bunch is either six or twelve, and they are tied so that when held up for display they fall apart loosely, thus showing each individual flower to advantage.

For transit to market a non-chargeable, non-returnable standard-sized wood box is recommended. The boxes used should be light, smart and business-like, those made of spruce wood being preferable. The ordinary-sized flower box is used for packing tulips with short stems, but for tulips with long stems, *viz.*, Darwin, Cottage Tulips, etc., all sizes of boxes are in use. In very dry weather, boxes are soaked in water before being packed with flowers, thus preventing the box absorbing water from the flowers. The very best non-absorbent paper is used to line the box and also cover the bloom. Sometimes each bunch, especially those which have been forced rapidly, is also wrapped in paper. The flowers are packed in rows with their stalks parallel to or at right angles to the long axis of the box. The former method is used for tulips with long stems and bloom is placed at each end of the box, but some growers pack them with bloom at one end only, so as to display the length of the stalk to advantage. In all cases flowers are packed tightly; and a wedge is generally placed in the middle of the box in the direction of its breadth, so as to prevent too much movement during the journey. Boxes are labelled, stating the name and address of the grower, the variety, the grade, the number of bunches in the box, and the number of flowers in a bunch.

Diseases and Pests of Tulips.—"*Fire.*"—The most important disease of tulips is "Fire" (Botrytis Tulipae), and it is known wherever tulips are grown. The symptoms are as follows: on the leaves arise small, yellowish, slightly elongated, sunken spots surrounded by a darker green area. These spots may enlarge, join together, and become grey or brownish in colour, so that large portions, or the whole leaf, may ultimately take on a dry, shrivelled appearance. When the spots are few in number the leaf is often twisted or deformed; the spots may even develop before the leaves emerge from the bulb. Spots also develop on the flowers, particularly red flowers, in which case the flowers appear blighted. If the flower is attacked

while in bud it may fail to open. The spots develop spores which distribute the disease, and, in addition to spores, compact masses of the mycelium of the fungus, called sclerotia, are formed towards the end of the season. The sclerotia are black externally when fully formed, and are commonly present on the old flower stalk, and to a lesser degree on the bulb scales, being thus distributed from place to place with the bulbs. In spring they develop and produce spores.

The severity of the attack depends largely on weather conditions, and is worst in wet weather. There is no known cure, but preventive measures should be adopted. Affected plants are removed and burnt; and bulbs when lifted, and also during storage, are examined, and destroyed if sclerotia are found to be present. Tulips should not be grown on land which has grown tulips the previous season, especially if they were diseased, for sclerotia are certain to be present in the soil.

"*Sclerotium Disease.*"—This disease, variously called "Sclerotium Tuliparium," "Rhizoctonia Tuliparium," and "Corticium Solani," is known wherever tulips are grown, but in England its occurrence is somewhat rare. The first indication of its presence is that planted bulbs fail to grow, or, if they do, the plant is stunted and soon dies. Dark brown sclerotia, turning black when dry, are formed on and about the bulbs and in the surrounding soil. And it is from them that attacks proceed. Affected bulbs are usually completely destroyed in the end. Diseased bulbs and the accompanying soil should be destroyed. As soil may harbour the disease for several years, tulips should not be planted in soil that has been infected. In the U.S.A. almost complete suppression of the disease has been obtained by applying a solution of 2 lb. of formalin in water per square yard so as thoroughly to wet the soil to a depth of 8 in. Steaming the soil by the inverted pan method has also proved successful in exterminating the fungus in small areas.

Pests.—Slugs feed on tulip bulbs, and regard the developing flower as a delicate morsel. The bulb mite (Rhizoglyphus Echinopus) may also do considerable damage. The methods of controlling and combating these two pests are described in the Ministry's Leaflets Nos. 132 and 136 respectively.

[The writer desires to acknowledge his indebtedness to Dr. Pethybridge, of the Ministry's Pathological Laboratory, Harpenden, for helpful criticism of the disease section, and to Messrs. Shaw and R. D. Wellhand, of Spalding, for many practical hints on growing tulips.]

TOUR OF A BLACKSMITH'S DEMONSTRATION VAN IN KENT

THE decline in the agricultural demand for farriers' work is reflected in the diminishing number of rural blacksmiths and of apprentices to the craft; and, as the disappearance of the local smith entails serious loss and inconvenience to a rural community, the question of compensatory openings for blacksmith's services is receiving serious consideration from agricultural authorities and organizations. The conference convened in this connexion by the Rural Communities Council at Maidstone was referred to in the April issue of this JOURNAL. Briefly, the scheme favoured is to induce the rural smiths, with the aid of additional plant, to take up general engineering, motor vehicle repairs, and other well-paid work which is at present sent into the towns.

Arrangement of Tour.—The Kent Education Committee, with this object, secured the loan last autumn of one of the Ministry's blacksmiths' vans for demonstrations in their area, and the results of the six months' tour, which ended on May 17 this year, are not without interest. The Committee's policy, adopted after consultation with the Kent branch of the Master Farriers' and Blacksmiths' Association and the Secretary of the Kent Rural Community Council, was to keep clear of the centres of large population and to locate the van at convenient places, five to six miles apart, evenly distributed throughout the whole county. Where a town appeared to be a convenient centre, a suitable spot was selected just outside its boundaries. From three to five days were spent at each pitch, according to the number of smiths attending the demonstrations and coming forward for individual instruction. All smiths within five miles of any stopping place were advised by post, the night before, of the advent of the van.

Attendance.—In all, twenty-nine centres were visited and 362 smiths attended to receive individual instruction, an average of 12 smiths at each centre. These smiths were of all ages, ranging from 17 to 60, the average being, perhaps, 35. Some held the R.S.S. Certificates, some were Associates of the Farriers' Company, while others had neither qualification. Included in the number were about 30 improvers and apprentices; also a few agricultural engineers and general smiths, and, perhaps, 30 combined smiths and wheelwrights. About a dozen farmers and eight garage proprietors also took an active interest in the van and watched demonstrations, but

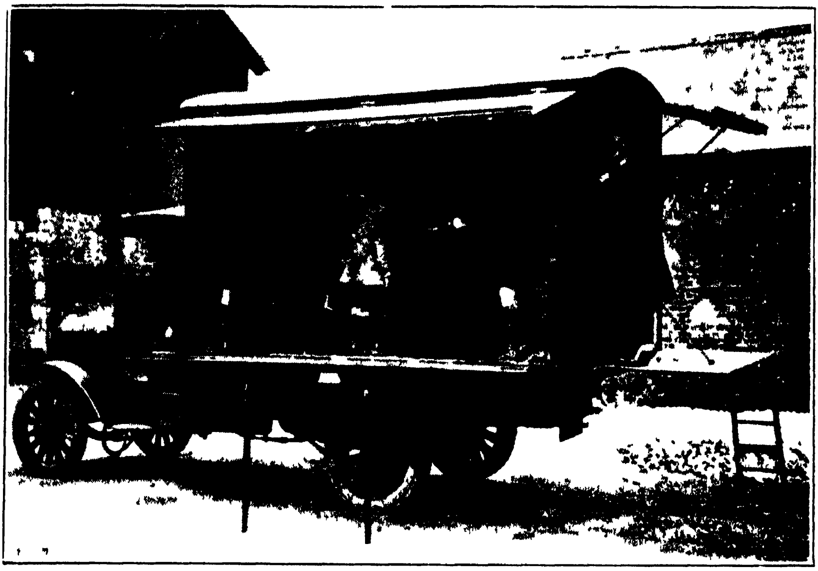
they are not included in the above attendance figures, with the exception of one garage proprietor who possessed an acetylene welding plant, but did not know how to use it. Details of the attendance at the various centres is given in the following table :—

Centre	No. of days	Dates	Average daily attendance	Number of individual smiths	Average No. of attendances by each smith
Sutton-at-Hone	5	Nov. 23-27 ..	14·0	18	3·9
Rainham ..	3	Dec. 8-10 ..	10·0	20	2·5
Sittingbourne ..	4	Dec. 11-16 ..	10·7	14	3·1
Sheldwich ..	4	Dec. 17-22 ..	6·5	10	2·6
Whitstable ..	4	Dec. 28-31 ..	5·3	7	3·0
Broomfield ..	5	Jan. 1-6 ..	7·0	11	3·2
Birchington ..	5	Jan. 7-13 ..	9·4	14	3·3
Broadstairs ..	5	Jan. 14-19 ..	6·0	9	3·8
Sandwich ..	5	Jan. 20-26 ..	12·0	19	3·2
Upper Walmer	4	Jan. 29-Feb. 2	5·7	9	2·6
Dover	5	Feb. 3-8 ..	6·4	11	3·0
Folkestone ..	4	Feb. 10-13 ..	7·7	11	2·8
Elham	3	Feb. 16-18 ..	6·7	8	2·4
Adisham ..	3	Feb. 19-22 ..	7·0	9	2·3
Chilham ..	3	Feb. 24-26 ..	7·0	9	2·3
Ashford ..	3	Mar. 1-3 ..	5·7	9	2·0
Harrietsham ..	3	Mar. 4-6 ..	5·3	7	2·3
Bearsted ..	3	Mar. 9-11 ..	7·0	11	1·7
Wateringbury ..	3	Mar. 15-17 ..	9·3	14	2·0
Wrotham ..	3	Mar. 18-22 ..	9·0	10	2·7
Sevenoaks ..	5	Mar. 23-27 ..	10·2	19	2·7
Westerham ..	3	Mar. 29-31 ..	11·3	19	1·8
Edenbridge ..	3	April 1-7 ..	9·7	14	2·1
Leigh	3	April 8-12 ..	8·3	11	2·3
Five Oak Green	5	April 13-17 ..	11·4	20	2·8
Cranbrook ..	3	April 19-21 ..	6·3	8	2·4
Hawkhurst ..	5	April 22-27 ..	7·4	14	2·6
Tenterden ..	5	April 28-May 3	13·4	19	3·5
Biddenden ..	3	May 13-15 ..	7·0	8	2·6
29 centres ..	112		8·4	362	2·7

The van was always open from 9 or 10 a.m. onwards and was kept open until from 9 to 10.30 p.m. according to the attendance and the amount of interest displayed. The evening demonstrations usually started about 5.30 p.m., but the busiest time was about 7 p.m. Of all the van plant, the acetylene welding and cutting plant undoubtedly evoked the most interest, the emery grinder coming next. Several smiths were interested in the lathe, and a few in the power-driven upright drill. The lathe, when the tour commenced, was driven by treadle, but, after conversion early in March to power driving, became more popular. It should be noted that the smiths attending brought numerous broken pieces of farm implements

Photo] [Special Press

Demonstration to Blacksmiths in progress at Penshurst
Tour of a Blacksmith's Van in Kent



The Van at [illegible]. Demonstration to Schoolboys in progress.

Pl. [illegible] [Special Ph[illegible]

Acetylene Welding Demonstration to Schoolboys at Penshurst.

Tour of a Blacksmith's Van in Kent.

and machinery on which the demonstrator could operate, and it was never necessary to buy material for the purpose. Hay forks, three-prong forks, spuds, and such like were the articles most frequently brought for repair. Larger jobs were an axle casing for a farm mowing machine and an engine casing which had been broken into four pieces. Individual instruction in acetylene welding was given on scrap pieces of metal.

School Visits.—With the object of interesting the elder boys of elementary schools in the work of a village smith, as a possible career, the Kent Education Committee arranged in February for parties of local boys of 12 to 14, in charge of their schoolmaster, to visit the van when located at a village centre. These visits took place at twelve centres, 296 boys in all attending in parties of fifteen or sixteen at a time, each party being given a demonstration, lasting three-quarters of an hour, in the use of the various appliances. Very considerable interest was shown by them, especially in the acetylene welding. The centres at which school visits were paid and the attendance figures were as follows :—

Centre	No. of boys
Elham	17
Adisham	16
Chilham	13
Harrietsham	16
Bearsted	28
Wateringbury	20
Wrotham	35
Westerham	35
Leigh	20
Five Oak Green	31
Hawkhurst	50
Tenterden	15
Total	296

Running Expenses.—Some particulars of the running expenses of the van during the tour will be of value. These were as follows :—

	£	s.	d.
December, 1925	8	10	0
January, 1926	6	5	6
February, 1926	6	11	1
March, 1926	6	11	0
April, 1926	4	15	0
May, 1926	9	1	0
	£41	13	7

These figures include driver's remuneration, petrol, lubricating and other oil, minor repairs and replacements, road tolls, hire of ground for van where required, charging of accumulators for lighting, carriage on cylinders of acetylene

for the welding plant, and postages, etc. The figures for the first and last months are rather abnormal, due in December to a charge for painting the Committee's name on the van and the purchase of a pail and an oil stove ; and May, when the van was only in use for half the month, to a charge for a general overhaul of the engine and plant, cost of replacing consumable stores of metal rods, etc., before handing over.

In addition to the expenses, shown above, the cost of the cylinders of gas for the whole period amounted to £6 18s. 9d., insurance for the six months, £14 7s. 3d., and there was also the demonstrator's salary and subsistence allowance on the Committee's scale.

Results of the Tour.—The County Agricultural Organizer reports that the tour has done very useful work in the county by opening the eyes of the smiths to what can be done with the acetylene welding plant, and he is of opinion that many broken parts of machinery will not be scrapped in the future now that the smiths have seen that they can be welded. That the demonstrations provoked unusual interest was proved by the majority of the smiths attending each day that the van remained in their district. A number of them expressed their intention of investing in acetylene welding plant and an emery grinder ; and several orders for plant have been placed through the Kent Rural Industries Co-operative Society, Ltd., which has also received a number of tentative inquiries. The Secretary of the Society has a list of the smiths attending the demonstrations and is following them up by letter and personal visit. It will be some time before all have made up their minds to place orders, however, and a number will probably prefer to buy plant direct from their usual dealers.

Generally.—A drawback to the tour was the fact that it was conducted during the winter months. The weather at the start was bitterly cold, and the demonstrator originally engaged by the Education Committee caught a chill at the end of the first week and was unable to resume duty, the remainder of the tour being conducted by the Committee's Farriery Instructor, Mr. Wardley. The evenings were dark, and, with the inclement conditions prevailing, the sides of the van, which are made to open out, had to be kept closed except for one or two rare occasions on afternoons in April. The back of the van only being opened was a handicap when a considerable number of smiths were in attendance ; and, even then, it was very cold work inside, despite the oil stove which had been purchased for warming the van.

DANISH BACON FACTORIES, AND THEIR LESSONS

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THE great importance of the Danish bacon factories—particularly from the point of view of this country, which is Denmark's principal market for pig products—is now widely recognized. In a recent article on the preparation and marketing of bacon, Sir Henry Rew, K.C.B., says:—

> The bacon business of Denmark has been built up on the factory system, organized mainly by the farmers themselves on co-operative principles. . . . Nowhere have the production and marketing of bacon been brought to so high a pitch of technical efficiency. From the birth of the pig to the sale of the bacon in England every stage has been carefully systematized. . . . In this, as in all other forms of commercial enterprise, the needs of the market can only be regularly supplied if the business of production and distribution is efficiently organized and modern methods are utilized to the very fullest extent possible.

The first Danish bacon factory was built just over thirty-five years ago. Others quickly followed and their history is one long record of steady progress. To-day, there are in Denmark nearly fifty co-operative bacon factories and a further fifteen similar establishments privately owned. These together deal with 85 per cent. of all the pigs reared in the country.

It is interesting to note the distribution of the factories in Denmark, which are very much more numerous in the east than in the west. The reason is not difficult to find for it is, roughly speaking, in the western third of the country that most of the large farms are found. In the remaining two-thirds, the agricultural land is divided almost entirely into small holdings and, under these conditions, organized co-operation is not a luxury but a necessity, if the most is to be made of the farmers' efforts.

Initial Difficulties.—The account of the early difficulties, so admirably described by Harald Faber,* is exceedingly interesting and will be appreciated by those who are in this country to-day responsible for the running of some of our English bacon factories. On December 22, 1887, the first killing was done in the first Danish co-operative bacon factory, for which a sum of £9,400 had been guaranteed by 1,100 co-operators, who had also undertaken to deliver 10,500 pigs annually for a period of seven years. The capital was not

* "Co-operation in Danish Agriculture."

actually put up by the members, but was advanced by the bank on their joint and several guarantee.

This co-operative undertaking met at first with considerable opposition from several quarters. Owners of private bacon factories and dealers, who used to buy pigs in the district, were naturally against it. The papers published letters to prove that the production of bacon pigs did not pay. Local banks refused to advance the necessary capital, which was, however, obtained from a savings bank in another town. The sanitary committee of the town raised strong objections on the ground that such a factory might be injurious to public health. In spite of all opposition, the factory went up and, during the first year, 23,000 pigs were killed—a much larger number than was expected. This good result was obtained in spite of a keen competition from private curers who raised the price of pigs to prevent the co-operative factory from buying. Many farmers, especially among the larger landowners, considered it too risky to bind themselves to deliver their pigs to a co-operative factory and to guarantee such large sums for building and working capital.

Growth of the Movement.—In spite of all opposition the movement grew and four more co-operative bacon factories were erected in 1888, an additional four in 1889, and in 1897—ten years after the first co-operative factory had been built—no fewer than twenty-four were in existence. Of these, eight were in Jutland and sixteen on the islands. The rapid growth of these factories meant to the Danes difficulties with which we are confronted in this country to-day. It was difficult or almost impossible, at that time, to find sufficient men of the right type as managers—men skilled on the technical and the business side. Experience was lacking as to the best method of building a bacon factory, while the equipment at that time often left much to be desired. During those first years the Danish co-operative bacon factories had to do what we are doing to-day—buy their experience, and, sometimes, buy it pretty dearly. That they learnt their lesson is seen by the fact that only two of those factories actually closed down. From that time onwards, the number of bacon factories has steadily and consistently increased, and time has shown that the co-operative bacon factories have been more than able to hold their own.

Pigs or Bacon Factories First?—We often hear, in this country, that it is no use building bacon factories until we have

the pigs, but the Danes found that the pigs came with the coming of the factories. In 1837 there were in Denmark 235,000 pigs, and in 1881 527,000. After the opening of the co-operative bacon factories in 1881 the number of pigs in the country increased, steadily and rapidly, until in 1914, at the outbreak of the war, the number stood at approximately 2½ millions. During the war the stocks had to be denuded as, with the difficulties of obtaining foodstuffs, it was impossible to feed them. In 1920 the numbers were back to just over a million; in 1921 to nearly a million and a-half; in 1922 to more than a million and three-quarters; and in 1923 to just under three millions. This rapid growth of the pig population in Denmark, with the growth in the number of co-operative bacon factories, stands out in marked contrast to what has been happening in this country. While, during the last fifty years, the pig population in Denmark has increased more than five-fold, in this country it has remained approximately constant, alternately rising and falling, but with no real change in the general levels, although the imports of pig products, mainly in the form of bacon and ham, have increased by leaps and bounds.

TABLE I.—UNITED KINGDOM*

PIG POPULATION AND IMPORTS OF PIGMEAT

(not including meat from live pigs imported)

Year	Pig Population	Imports of Pigmeat				
		Quantity	Declared Value	Per Head of Population		
				Quantity	Value	
		cwt.	£	lb.	s.	d.
1871 ..	4,136,616	1,389,982	3,419,005	4·9	2	2
1881 ..	3,149,173	5,009,010	11,411,496	16·1	6	7
1891 ..	4,272,700	5,069,328	10,040,418	15·0	5	4
1901 ..	3,411,129	8,671,574	20,158,365	23·4	9	9
1911 ..	4,250,013	6,513,030	18,803,841	16·1	8	4
1921 ..	3,628,116	7,558,853	55,658,996	17·9	23	7
*1925 ..	2,910,988	†10,355,072	†57,696,030	†25·7	†25	7

* Figures for 1925 exclude the Irish Free State data, but in the case of imports include those from that State into Great Britain and Northern Ireland.

† Provisional figures.

In England we say "pigs are either muck or money," and we increase or decrease the number according to the rise or fall

in the market, with the result that it has remained approximately stationary at somewhere about the 2½ million line—just about the figure that satisfied the pork market—and until quite recently most of our pigs have been going for pork. When the number has risen well above the 2½ million line we have had too many for pork, the price has gone down, and farmers have given up breeding pigs. When the number has fallen to less than 2½ millions we have had a comparative scarcity, the price of pigs has gone up, and farmers have again taken to breeding. The sow is a very accommodating animal and quickly, if need be, rises to the occasion, with the result that the required increase can be speedily obtained.

There is, however, very little doubt that if all our pigs are to go for pork, the keeping of pigs must cease to be remunerative whenever their number in this country rises to over 2½ millions.

It is to meet our increasing demands for bacon that the Danes have been steadily increasing their pig population, sending almost the whole of their pigs to the bacon factories, and exporting practically the whole of their bacon to this country. The following figures, taken from the Statistical Year Book for Denmark, 1924, show that, during the three years mentioned, no less than 99·98 per cent. of Denmark's total export of bacon has been sent to this country.

TABLE II

EXPORTS OF BACON FROM DENMARK

Year	To Great Britain Hundred Kilograms	To other countries Hundred Kilograms	Total exports Hundred Kilograms
1921 ..	845,866	269	846,135
1922 ..	1,110,556	131	1,110,687
1923 ..	1,710,114	419	1,710,533
	3,666,536	819	3,667,355

Destination of Denmark's Pigs.—A study of the yearly reports and balance sheets of the various co-operative bacon factories in Denmark reveals quite clearly the destination of the pigs. Thus in the case of one of the twelve factories which we had the opportunity of visiting last year, out of a total of 23,122 pigs slaughtered in 1923 :—

18,840 or	81·5	per cent.	were sent to England.
3,338 or	14·4	,,	were dispersed in Copenhagen.
783 or	3·4	,,	were dispersed locally.
77 or	0·3	,,	were sent to Germany.
84 or	0·4	,,	were destroyed.

Apart from Ireland, the main sources of our imported bacon have been, for some years, America, Denmark, and Canada. In 1900, of our imported bacon :—

70·1	per cent.	came from the	United States.
19·4	,,	,,	Denmark.
9·4	,,	,,	Canada.
1·1	,,	,,	other countries.

From that time onwards, a determined effort was made by the Danes to capture the English bacon market, with the result that in 1914 no less than 53 per cent. of our total bacon imports came from Denmark.

Price of Danish Bacon.—It is interesting, too, to find not only that Danish bacon has been getting a more and more firm hold on the English market, but also that the price which it has been fetching has been well above that made by either the American or the Canadian product, though well below that made by Irish bacon.

TABLE III. -AVERAGE DECLARED VALUE PER CWT. OF IMPORTED BACON

Imported from	1923 s.	1923 d.	1924 s.	1924 d.	1925 s.	1925 d.
Irish Free State ..	107	10	106	1	126	9
Denmark ..	111	3	101	11	118	7
United States	81	5	78	2	100	3
Canada ..	92	3	92	1	108	1
Other countries	104	8	95	4	107	2
Average ..	98	0	95	0	112	10

While, in 1924, Denmark sent us 50·6 per cent. by weight of the bacon we imported, she received 54·3 per cent. of the money paid for imported bacon.

Reasons for the Growth.—Since 1920, a determined effort has been made by the Danes to capture the English bacon market and, with this object in view, not only has a careful study been made of the requirements of the English trade as a whole, but of the special requirements and demands of different districts. It is interesting to watch the grader at work in the factory; each side of bacon comes directly under his eye, and those passed for the English market are again selected by him

for consignment to the London, Manchester, Birmingham, Leeds, or Newcastle market, as the case may be. With him the English market is a sacred institution to which nothing but the best must be sent; it is indeed the very life of his industry, and upon the standardization of a uniformly good article his success has been built.

It is probable that tuberculosis among pigs is more common in Denmark than in this country, but each carcass is personally inspected by a qualified veterinary surgeon and no animal showing any signs of this disease can possibly obtain the "Lur" mark, or hall mark for the English market. It is very interesting to note that of the pigs which have been rejected for export, up to 90 per cent. may be passed as first-class for home consumption. But for the English market—nothing but the best.

In the case of Factory No. 5, to which reference will be made later, which in 1923 handled 60,469 pigs, 4,206 or 6·9 per cent. were found to show signs of tuberculosis and were consequently rejected for the English market. Of these no less than 3,872 or 92 per cent. were passed as first-class for home consumption; 225 or 5½ per cent. were passed as second-class for home consumption; and 109 or 2½ per cent. were destroyed as unfit for human consumption, the latter corresponding to 0·18 of the total pigs passing through the factory. During the war period, when pigs were being run on to a heavier weight and a larger proportion were being sent to Germany, a much higher percentage of animals were found to be infected.

The demand of the British public is for bacon, not too fat, coming from a side weighing from 56 to 62 lb.; this determines to a large extent the weight of the pig required—one of approximately eleven stones dead weight. This is obtained by the very simple method of making uniform and fixed deductions in proportion to the extent to which the pig is above or below the weight required. The Danes have realized that the best way to educate a man is to educate him through his pocket. Thus in the office of one of the factories, which we visited during August, 1924, the following notice was posted :—

WANTED PIGS

60 to 70 kilos dead weight ..	Price paid : 220 Ore per kilo
70 to 75	Deduction of 2 Ore
75 to 80	4 Ore
80 to 85	6 Ore
85 to 100	10 Ore
55 to 60	4 Ore
50 to 55	10 Ore

As this system is in vogue in practically every factory, pigs, wonderfully uniform in weight, are invariably sent in, with the result that the average weight of all the pigs in all the factories which we visited was within the range of 64 to 67 kilograms dead weight.

Management.—The question one naturally asks is, does it pay the Dane? The answer one has to give is, undoubtedly, yes. It follows from either a detailed study over a large number of years of any particular factory, or by a similar study of all the factories in any one year.

The following details with reference to Factory No. 5 show that 1,071,026 pigs have been passed through the factory during the last twenty-eight years, and by their sale have realized a total of £5,837,154, or an average of £5 9s. 0d. per head, and have left a net profit of £378,774, or 7s. 1d. per pig. In every one of the twenty-eight years the factory has been run at a profit. In addition to the profits, a total amount of £16,224 has been written off the value of the buildings, which at the end of the last financial year were standing at little more than £2,000.

TABLE IV.—OUTPUT, DANISH FACTORY NO. 5
In periods of four years

Years	Number of pigs handled	Total sales	Total profit	Written off for depreciation
		£	£	£
1896–99 ..	86,648	249,456	16,431	1,433
1900–03	128,594	440,895	24,715	1,928
1904–07	176,984	609,495	35,893	2,204
1908–11	191,236	741,997	48.931	3,304
1912–15	213,621	1,082,754	60,035	3,274
1916–19	115,610	1,187,725	99,318	1,882
1920–23	158,333	1,524,832	93,451	2,199
Total ..	1,071,026	5,837,154	378,774	16,224

In co-operative societies of this description, their success depends, however, not so much upon a study of the profit and loss account, as in the case of a joint-stock company, but rather upon what price—partly in the way of initial payment and partly in the way of bonus—the members have received in return for the pigs sent to the factory. In this respect a study of the following table, giving the initial bonus and total payment per pig and per stone dead weight, calculated at the indicated rates of exchange, shows that the prices which the members have obtained will certainly well bear comparison with the price received by our English farmers.

TABLE V.—PAYMENT FOR PIGS, DANISH FACTORY No. 5
(Average payments over four-year periods)

Years		Rate of Exchange Par 18·159	Initial Payment per pig			Bonus Payment per pig			Total Payment per pig			Total Payment per stone		
		Kr. to £	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1896–99	..	Par	2	10	11	0	4	0½	2	14	11½	0	5	6
1900–03	..	,,	3	1	7½	0	3	10½	3	5	6	0	6	6¾
1904–07	..	,,	3	2	0½	0	4	1	3	6	1½	0	6	7
1908–11	..	,,	3	10	0	0	5	2	3	15	2	0	7	3
1912–15	..	18·32 Av.	4	12	6½	0	5	7½	4	18	2	0	9	2⅜
1916–19	..	17·0 Av.	12	15	10	0	17	6½	13	13	4½	1	4	6¼
1920–23	..	22·87 Av.	9	16	9	0	13	4	10	10	1	0	19	7¼

The following prices actually paid in 1924 to the Danish farmers for pigs marketed co-operatively for shipment to the English market at seven of the bacon factories which we recently visited certainly leave room for thought.

TABLE VI

Factory	Average price per pig paid to the farmer			Average dead weight per pig in stones, and decimals	Average price per stone D.W paid to the farmer	
	£	s.	d.		s.	d.
“A	6	13	0	11·0	12	3
“B	5	19	0	10·7	11	2
“C”	5	17	6	9·8	12	0½
“D	5	17	0	10·6	11	0
“E	5	15	0	10·4	11	0
“F	5	14	0	10·4	10	11
“G	5	13	0	10·1	11	1

The question is, how is it done? The answer is, simply through good organization on sound co-operative lines.

Working Costs.—The working costs of the factories are cut down to the minimum, averaging in one case (No. 3) only 3s. 6½d. per pig and 5s. per pig in the case of the whole of the eleven factories visited. The working costs in the case of Factory No. 10 are apparently high (7s. 2¼d.). The data for this factory, however, were obtained during a visit to Denmark in April, 1924, and refer to the working for the year 1922, and we have no doubt that, were figures available for the same year as the others, they would have fallen more into line with the others.

The amount of detailed information given in the published reports and balance sheets of the various factories contrasts very strikingly with the meagre information presented to the members in the case of most of our English agricultural co-operative ventures. Although these balance sheets may not

TABLE VII.—WORKING COSTS OF DANISH BACON FACTORIES, 1923
Calculated at Cost per Pig
(The figures for No. 10 are for year 1922.)

Factory	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6		No. 7		No. 8		No. 9		No. 10		No. 11		Av.		Per cent.
	s.	d.	s.	d	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	
Wages: Manager	0	2¼	—		0	4½	0	1	—		0	5½	—		—		0	1¾	0	5¾	—		—		—
Office Staff .							0	3½									0	2¼	0	4¼	—		—		—
Workmen . .	2	0	—		1	6½	1	6¼	—		1	11¼	—		—		1	8	2	4¾	—		—		—
Total wages	2	2¾	2	0	1	10¾	1	11¼	2	2	2	4¾	2	4¼	1	10½	2	0	3	2¾	1	10½	2	2	43·4
Packing	0	6	0	7½	0	5½	0	5¼	0	4	0	5	0	6½	0	5¾	0	5¼	0	6	0	5¾	0	5¾	9·6
Salt and saltpetre	0	5½	0	4	0	2¾	0	3¼	0	3	0	4½	0	6	0	6	0	3¾	0	6½	0	3½	0	4½	7·5
Repairs and renewals .. .	0	4¼	0	2½	0	1½	0	2¼	0	2	0	0¼	0	3	0	2½	0	3¼	0	3	0	2½	0	2½	4·2
Fuel and light	0	4¼	0	3½	0	2	0	3¼	0	2½	0	3¼	0	4½	0	3½	0	3¾	0	8¼	0	6¼	0	3½	5·8
Advertisements, printing, office sundries, and stationery .. .	0	1½	0	2¾	0	1¼	0	2½	0	2¼	0	2	0	2¾	0	3¼	0	2	0	3½	0	0½	0	2¼	3·7
Taxes and insurance .. .	0	1¾	0	2	0	1	0	0¼	0	1	0	1	0	1¼	0	2	0	2¼	0	2¼	0	0¾	0	1½	2·5
Veterinary control of meat .	0	2½	0	2¼	0	2¼	0	2½	0	3	0	3	0	3	0	3	0	3½	0	5	0	5½	0	2½	4·2
Cost of delivery of pigs to factory	0	11	0	0½	0	1½	1	10¼	0	11¼	0	2½	0	0½	1	0½	0	9¼	0	8¾	—		0	8½	14·2
Directors' and Auditors' fees ..	0	0½	0	0¾	0	0¾	0	1½	0	0½	0	1¼	0	0¼	0	0¾	0	0¼	0	1¼	0	0¾	0	0¾	1·2
Joint activities	0	0½	0	0¼	0	0½	0	0¼	0	0½	0	0½	0	1	0	0½	—		0	0¾	—		0	0½	0·8
Sundries	0	2½	0	0½	0	0¼	0	2	0	3	0	1½	0	1½	0	1½	0	2¼	0	1¾	0	1¼	0	1¾	2·9
Total	5	7	4	2½	3	6½	5	10½	4	11	4	6	4	10½	5	4	5	0½	7	2¼	4	1¼	5	0	100

always be officially circulated among the different factories, there is no doubt that they are unofficially common property, and that the managers and members of the various co-operative bacon factories do study each other's results carefully and critically. We have no doubt that such an interchange of detailed information would be very much to the advantage of co-operative societies in this country and, possibly most of all, to the managers of the agricultural bacon factories.

Of these factory working costs, undoubtedly the heaviest is that of the total wages bill. In the case of some of the factories, all such payments, including manager's salary, office staff, and workmen's wages, are lumped together; in others, these items are taken separately, and the information available goes to show that the managers' salaries are not particularly high. The office staff is usually distinctly underpaid, while the workmen are receiving wages which will certainly bear comparison with those paid in this country. The following details are extracted from one of the factories handling 25,000 pigs a year.

WAGES

	£	£
Manager's Salary	450	
Commission	120	
		570
Chief of Office Staff		250
Two clerks at £93		186
Factory foreman		260
Fireman		200
Fourteen men at approximately £3 per week		2,223
Overtime and casual workers		177
		£3,866

While, as far as our information goes, it has not been found possible to correlate with any degree of accuracy in the one year the working costs of the individual factories with the number of pigs that they are handling—as management is undoubtedly an all-important factor—yet the records of individual factories for successive years show that the working costs do vary inversely with the number of pigs handled.

The working costs as given in detail on the various reports and balance sheets do not include anything for interest on the working capital, bank overdrafts, or mortgages, or even for depreciation of the buildings and plant. When these are added, as in the following table, it will be seen that the total cost of passing a pig through the factory and marketing it works out, on the average, at only 5s. 9½d.

TABLE VIII.—TOTAL COSTS PER PIG

Factory	Total working costs per pig	Interest on capital	Depreciation on plant and buildings	Total
	s. d.	s. d.	s d.	s. d.
No. 1 ..	5 7	0 4	0 2	6 1
No. 2 ..	4 2½	0 4½	0 3¼	4 10¼
No. 3 ..	3 6½	—	0 1½	3 8
No. 4 ..	5 10½	0 1¾	0 3¼	6 3½
No. 5 .	4 11	—	0 1½	5 0½
No. 6 .	4 6	0 3	0 2¼	4 11¼
No. 7 .	4 10½	0 2	0 1½	5 2
No. 8 .	5 4	0 3	1 0	6 7
No. 9 .	5 0½	0 4¼	3 4	8 8¾
No. 10 ..	7 2¼	0 1¼	0 1	7 4½
No. 11 ..	4 1¼	0 5	0 4¾	4 11
Average ..	5 0	0 3	0 6½	5 9½
Percentage .	86·3	4·3	9·4	100·0

There is no doubt that the cost of handling pigs in the English co-operative bacon factories will in most cases be considerably higher than this, due partly to the fact that higher salaries will have to be paid for management and clerical staff, partly to the expenses incurred in buying pigs, and partly to the large amount which will have to be allowed for depreciation of the buildings and interest on the capital sunk in bricks and mortar. On the other hand, as far as we have been able to trace, the average returns for the sale of offals should undoubtedly be higher in this country than in Denmark. From the figures available it would appear that the average return from the sale of offals apart from bacon amounts roughly to 10s. 6d. per pig in Denmark, a figure which in the case of one English bacon factory whose accounts we have studied in detail has been more than doubled.

Not all the factory reports have accounted for the sale of by-products in equal detail, but the following notes extracted from the records of Factory No. 4, and expressed in amounts per pig handled by the Factory in 1923, may possibly be taken as a typical illustration of the sales which usually occur.

Product	Sales per pig £ s. d.	£ s. d.
Bacon, pork, etc.		**5 8 7**
Sausage, brawn, etc.	**0 0 7**	
Fat and lard	**0 3 6**	
Offal and gut	**0 6 5**	
Total by-products		**0 10 6**
TOTAL SALES PER PIG		**£5 19 1**

Improving the Type of Pig.—Balance sheets and statistics would be of little avail if the closest watch were not kept upon every pig passing through the factory. This fact the Danes have been the first to realise. When one considers the assistance that is afforded to the breeders, it is hardly an exaggeration to say that the factory authorities watch over the pigs of their members from birth. Pedigree boars are supplied, shows are organized and prizes offered for breeding animals most nearly conforming to the required types ; and the production of first quality stock is encouraged by paying the highest price per kilogram for the best animals. In this way the breed of pigs in Denmark has been standardised so that a uniformity of breed and type has been evolved—the type that is most suitable in size and development to the requirements of the market for which it is destined.

Compulsory Clause.—The Danes have realised that if the factory is to be run as a financial success it must be kept working at full pressure all the year round and that it must be supplied with a regular and constant number of pigs. The following extract, taken from the Rules of Society No. 4, is certainly, in this respect, worthy of consideration :—

> Every member must surrender to the factory the whole of his output of pigs . . . Delivery contracts shall, however, not include pigs which are killed for personal use, or which are sold to a day labourer working for the member concerned ; nor do they include breeding animals and pigs under four months old. Should any member sell contrary to this rule, he becomes liable to a fine of 25 kroner (about £1) for each pig which is thus unlawfully sold. Fines are payable to the factory.

While in the United Kingdom any co-operative bacon factory would be very unwise to insist upon its members sending the whole of their pigs for bacon, yet in our opinion there is no doubt that some sort of compulsory clause may have to become necessary and members will have to guarantee, in the interests of their society, a definite number of pigs each year. In the case of one particular co-operative bacon factory in this country, the aggregate number of pigs guaranteed by the members is approximately one-third of their total output, the remaining two-thirds being destined for the pork market.

Monthly Variation in the Number of Pigs Passing Through the Factory.—The following table, giving, in the case of three factories, the number of pigs handled each month in 1923, shows that, while it has not been found possible even with Danish organisation to ensure a perfectly regular and even

supply of pigs each week, yet there has been no time when the factories have not been kept busy.

TABLE IX

Month	Factory No. 2	Factory No. 3	Factory No. 5
January	8,433	6,932	4,812
February	7,735	5,632	4,415
March	6,950	6,235	4,355
April	7,460	6,723	4,643
May	11,181	7,675	6,552
June	7,380	7,222	4,069
July	9,175	7,387	4,423
August	12,002	7,630	5,729
September	9,070	7,141	5,234
October	11,352	8,544	6,468
November	10,536	9,354	6,000
December	7,482	6,299	5,164
Total	108,756	86,774	61,864

Method of Financing the Societies.—In no case has it been possible to study the records and balance sheets of any one of the individual societies from the date of its commencement, but sufficient evidence has been available from the published records to give a very clear idea as to the methods apparently adopted. A study of the liabilities of the societies at the end of the last financial year shows quite clearly the way in which they are at present being financed. In the case of two only, No. 4 and No. 7, is there any evidence of " share capital " in the concerns. In the other cases, any " share capital " which may have been previously invested by the members has been redeemed out of accumulated profits, though it is more than probable that such " share capital " has never been put in by the members.

The indications are that the undertakings have been originally almost, if not entirely, financed by the banks on the joint and several guarantee of the members, and later, on the security of the deeds of the completed buildings and equipment. The financial soundness of their position at the present time can be readily seen from a glance at Table X. It will be seen that, with the single exception of No. 11, the members own 60 per cent. and over of the capital invested in the business, and that in spite of the fact that apparently only in two cases has any money actually been paid in by the members themselves.

It will be noticed that, as a rule, a very small proportion of the accumulated profits is now being carried to reserve, except

TABLE X.—DANISH BACON FACTORIES—LIABILITIES

Factory	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
Number of pigs ..	154,771	108,756	86,774	81,160	61,864	61,856	59,741	50,306	38,613	23,992	14,852
	£	£	£	£	£	£	£	£	£	£	£
Accumulated Profits—											
(a) Reserve fund ..	53,567	—	9,538	7,960	676	—	3,714	3,612	5,157	1,559	—
(b) Bonus due to members ..	39,341	25,258	25,020	29,056	26,118	—	14.479	15,093	10,724	14,305	2,205
(c) Balance to carry forward ..	—	134	127	180	600	—	—	142	18	295	106
Share capital	—	—	—	11,682	—	—	10,296	—	—	—	—
Bank Overdraft and Mortgages	44,166	10,897	2,438	12,138	1,154	—	1,920	11,411	5,072	2,435	5,241
Trade Creditors ..	14,403	2,279	1,068	10,281	3,493	—	2,799	—	227	—	—
Total	151,477	38,568	38,191	71,297	32,041	—	33,208	30,258	21,198	18,594	7,552
Per cent. of capital originally paid in by members	0·0	0·0	0·0	16·4	0·0	—	31·0	0·0	0·0	0·0	0·0
Per cent. of capital now owned by members	61·3	65·8	90·8	68·6	85·5	—	85·8	62·2	75·0	86·8	30·6
Capital invested per pig	18s. 7½d.	7s. 1¼d.	8s. 9¾d.	17s. 7d.	10s. 4d.	—	11s. 1¼d.	12s. 0½d.	11s. 0d.	15s. 6d.	10s. 2d.

in cases in which a fund is being accumulated for the putting up of new buildings, by far the larger proportion being distributed each year to the members. On the other hand, they apparently do err on the safe side in writing down fairly drastically each year the value of their buildings and equipment, many of which are now standing at ridiculously low figures.

Method in which the Capital is Invested.—A study of the assets, which have been plotted in the Diagram, shows that in almost every case the money in buildings and equipment forms a very small proportion of the total capital. This is partly because they have been drastically written down in the past and partly because, though convenient, they have never been very elaborate or expensive. In this respect the Danish bacon factories are very similar to many of the South Wales agricultural co-operative societies. Possibly one of the most important points in the financing of the Danish bacon factories is the fact that they carry a comparatively small amount of stock in proportion to their turnover, and also have a comparatively small amount of outstanding accounts.

From a study of the balance sheets and trading accounts of the societies, the inference can be drawn that approximately one week's supply of pigs will be in the factory and an additional week's supply, not yet paid for by the merchants or factors to whom they have been dispatched. As the members can receive payment for their pigs on delivery, this means that the factory has practically to be financed for a fortnight only. For this, the quick "tank" method of cure, universally adopted in Denmark in every one of the factories visited, is, in our opinion, largely responsible. While there may be differences of opinion as to whether the tank method or the dry method of curing gives a better bacon, there can be no question as to which method requires the smaller amount of working capital.

TABLE XI

Factory Number	Days' supply in stock	Days' supply unpaid for	Days' supply to be financed
1	4·7	9·8	14·5
2	5·9	5·4	11·3
3	5·2	4·6	9·8
4	10·3	5·4	15·7
5	11·4	6·4	17·8
6	—	—	—
7	7·3	5·3	12·6
8	16·7	5·1	21·8
9	12·1	5·9	18·0
10	14·6	3·8	18·4
11	6·4	7·6	14·0

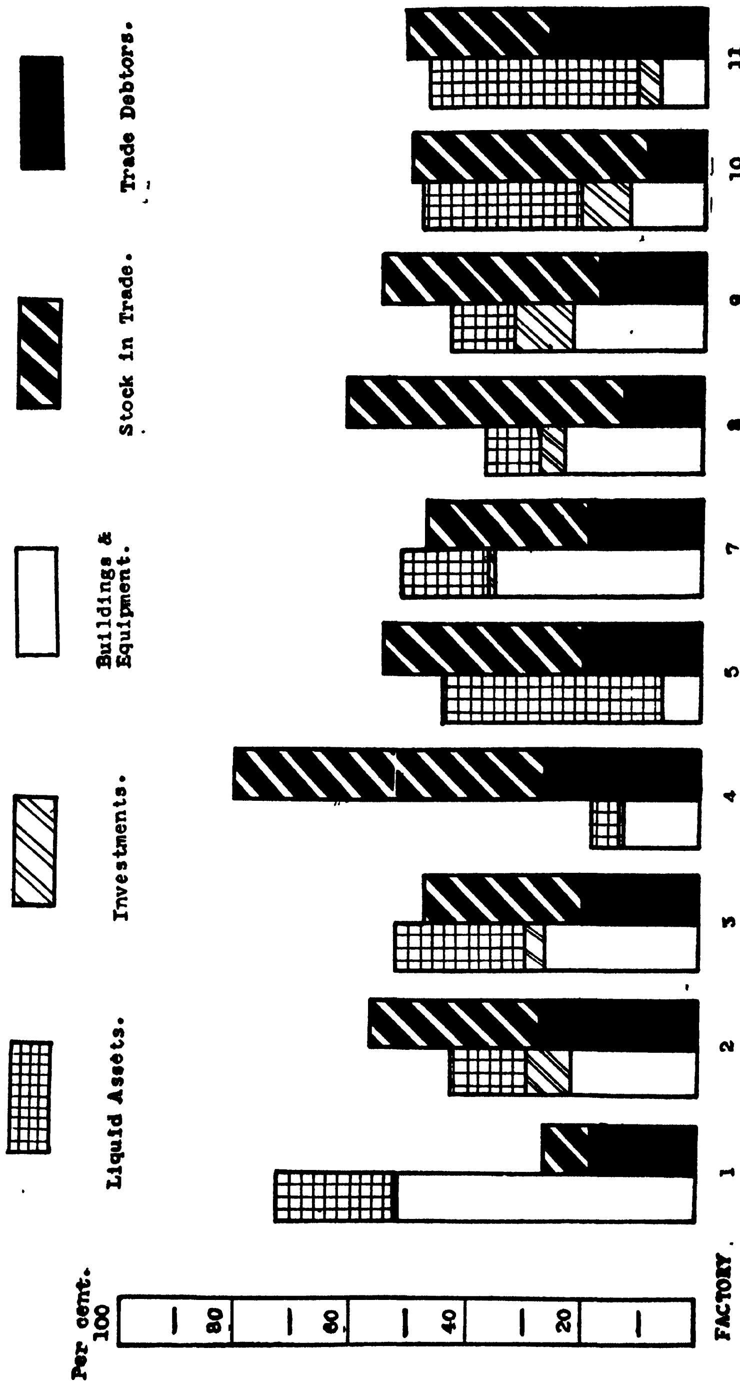


Diagram illustrating the division of assets in ten Danish Bacon Factories.

In the case of the three English co-operative bacon factories which have been in operation for any considerable length of time, and none of which, as far as we have been able to see, has adopted the tank method of curing, the capital required, per pig dealt with, has varied from 14s. 10d. to £2 13s. 0d.; *i.e.*, inversely with the number of pigs killed.

TABLE XII.—CAPITALIZATION OF ENGLISH BACON FACTORIES

	A.	B.	C.
Time of opening factory ..	1912	1912	1919
Number of pigs killed in 1923 ..	52,573	12,067	4,844
Number of pigs killed per week	1,011	231	94
Total capital invested	£37,113	£21,225	£12 750
Capital required per pig dealt with	£0 14s. 0d.	£1 15s. 0d.	£2 13s. 0d.

Membership.—While very few of the reports of the Danish factories give any indication as to the number of supplying members, yet this information is available in the case of Factory No. 4. During the year 1923, 840 new members were enrolled, bringing the total membership up to 4,174. This would mean that the average number of pigs sent to the factory amounted to nineteen per member, while only two members sent more than fifty. The balance sheet shows that the total liabilities of the Society at the end of the financial year amounted to £71,297 or £17 2s. 0d. per member, made up as follows :—

		£	s.	d.
Share capital invested	per member	2	14	6
Reserve fund	per member ..	1	19	6
Bonus due	per member ..	7	0	0
Bank overdraft	per member ..	2	18	6
Trade creditors	per member ..	2	9	6
Total liabilities	per member	£17	2	0

Thus, while each member has paid into the Society only £2 14s. 6d., there was standing to his credit at the end of the financial year 1923, £11 14s. 0d., of which he would actually draw out £7 0s. 0d. It certainly speaks well for the business organization of a society like this, when the members draw out each year in the form of *bonus* approximately three times the share capital they have paid in.

Conclusion.—There are one or two points so well brought out in the Danish accounts under examination as to deserve special mention by way of recapitulation.

First, all the factories are definitely out to help the farmer. This is demonstrated in many ways. There is the assistance given towards the improvement of the livestock, the advantageous price paid for first quality animals, and at the same time the willingness to take even wrecklings and fallen animals off the farmer's hands. Some factories, indeed, arrange for the slaughter of a limited number of cattle on co-operative lines, but this service has not yet grown very much.

The second important point concerns the consumer. The Danish factories are out to give the consumer what he wants and not what they "think he ought to have." This is surely a sound policy, but it is a lesson which has not yet been altogether learnt in this country.

A third point is the extent to which Denmark relies upon her export trade and her overseas markets, especially in the United Kingdom. She is sending over hundreds of thousands of pigs annually to this country and is paying a bonus of, on the average, 6s. to the breeder on each one, even at times when pigs in this country have been suffering from the severest of slumps.

Another detail is the effect of the war upon the bacon factories and in this instance the interest is twofold. Very briefly, there is the way in which, and the extent to which, the factories were able to adapt themselves to the emergency conditions, and there is also the remarkable way in which recovery has been made from the war-time state of depression.

Finally, as to the present position and outlook of the Danish bacon factories, it may be said that, almost without exception, they are in a most flourishing condition. While there is no doubt that the co-operative bacon factories in Denmark have proved an unqualified success, in spite of their early difficulties and disappointments, we see no reason why success should not attend similar enterprises in this country, provided that they were managed on the same sound business lines, and that the English farmers gave to them the loyalty and support which the Danish co-operative factories receive from their members.

RHUBARB CULTIVATION

Introductory.—For over half a century the cultivation of the rhubarb plant for winter and spring use has been a staple industry in the Leeds district of Yorkshire, the Glasgow district of Lanarkshire, and, to a lesser extent, in Middlesex; in these districts, too, the crop has long been cultivated in the ordinary way for summer consumption. It is difficult to determine why rhubarb growing should be so highly localized. The plant flourishes in most gardens, it is usually easy to grow, it suffers from few pests or diseases, and it may be had in season, if forcing is resorted to, from January to August.

Production.—(*a*) *Soil.*—The essential property of a soil suitable for rhubarb growing is moisture-retaining capacity. The ideal soil is a rich loam, with a good open subsoil, but under good treatment the plant does well on a wide range of soils. A thin dry soil should, however, be avoided, as also any soils that are waterlogged.

(*b*) *Preparation of the Land.*—The land should be deeply ploughed, to a depth of 12 or 14 inches, as early as possible in autumn, and preferably after a cereal crop or potatoes. A dressing of farmyard manure, up to 40 tons per acre, should be applied, the time of application being dependent on the nature of the soil. On the heaviest soils, the manure may be applied and ploughed in during autumn, while on the lighter soils half may with advantage be applied before the autumn ploughing and the remaining half applied and worked in by cross-ploughing shortly before planting. After the winter frosts have helped in the weathering of the surface soil, surface cultivation should be practised to secure a good tilth.

(*c*) *Planting Out.*—This is done during February or early in March. The sets (*see* "Propagation," below) are ploughed in from 8 to 10 inches deep, or sufficiently deeply to ensure that the highest crown is covered by some 2 inches of soil. From 30 to 36 inches is allowed between the sets, and a similar distance should separate the rows.

(*d*) *After-treatment.*—The treatment of young crowns varies according to locality and to whether the crop aimed at is "Natural" rhubarb, *i.e.* rhubarb grown in the open to be harvested during the summer and autumn, or "Forced" rhubarb, to be grown indoors for the winter and spring markets.

Natural Rhubarb.—When the young sets have had time to "fibre in" (*i.e.* to establish their root system) a moderate dressing of sulphate of ammonia, not more than 2 cwt. to the

acre, may be applied to stimulate growth. During the first growing season the only tillage operation necessary is shallow scuffling, to keep down weeds and preserve a surface mulch in order to minimize loss of soil moisture.

In the spring of the second year of growth a light dressing of farmyard manure is advisable, though this is not general practice. The crop is a gross feeder, and as a purely vegetative growth is aimed at, farmyard manure should form the basis of the manurial scheme. Surface cultivation, to keep the land free from weeds, must be practised very thoroughly throughout the growing season. Towards the end of April, a moderate top-dressing of sulphate of ammonia may be given, 2 cwt. per acre being adequate in most cases. The first pulling should be light, and care must be exercised to avoid dislodgment of the crowns. After two pullings, a further dressing of either sulphate of ammonia or nitrate of soda should be applied. During this second year, it is not advisable, as a rule, to take more than three pullings from the crowns.

The treatment during the following years will continue on the same lines, but as the crowns gain in size and strength the stalks may be pulled more severely, as many as five pullings being possible where it is economic to manure liberally.

In addition to the farmyard manure, applied during the third and subsequent years, phosphatic and potassic manures are essential. A dressing which has been found to be highly successful consists of :—

4 cwt. Superphosphate (30 per cent.)	per acre.
1 cwt. Steamed Bone Flour	
2 cwt. Sulphate of Potash	

At present-day prices, the potash in sulphate of potash costs about 60 per cent. more per unit than does the potash in muriate of potash, and the above dressing, therefore, might well be modified by replacing the sulphate of potash by a slightly smaller quantity of muriate of potash. This dressing should be applied during the third year, and every subsequent year, until finally the crowns attain sufficient size to warrant splitting up, usually from five to six years from the time of planting the young sets, the actual period varying with soil differences and with treatment in respect of manuring and cropping. When it is desired to split up old-established crowns, these should be ploughed out either in the autumn or in early spring.

From the point of view of plant hygiene, it is essential that the land should now have a rest from rhubarb, and a rotation of crops, the nature of which will be determined by the size

and character of the farm, should be adopted, so that there may be an interval of at least three years between successive series of rhubarb crops.

The importance of liming must be borne in mind, and as a rule it is more profitable to lime at short intervals rather than once in the rotation. In either case, lime should be applied just before rhubarb is to occupy the land. Whatever form of lime is used, and whether it is applied in medium dressings at short intervals or in heavier dressings at longer intervals, the amount given should be such as to supply 4 to 5 cwt. of quicklime each year.

Forced Rhubarb.—The production of forced rhubarb is sometimes combined with that of natural rhubarb, but in many cases the forced crop only is produced. In either case, the treatment of the crowns preparatory to their being forced is the same, except that in the case of forced rhubarb, where the natural outdoor crop is first taken, the crowns will require a longer time in the open before being forced.

There is apparently no definite standard laid down as to the time necessary to produce crowns suitable for forcing, and this is largely a matter for the individual grower, who should be the best judge of how to husband his stock of roots. The rate of root growth will naturally vary with different soil and climatic conditions.

Generally, in the Leeds area, *Prince Albert* roots are lifted for forcing after two years, and *Victoria* after three years, in the open. In the Glasgow district it is customary to give each variety an additional year outside and, in some cases, *Victoria* is given five years before being forced. In this area, however, *Victoria* is usually treated as a dual-purpose variety, yielding first the natural crop, and finally, forced rhubarb.

The treatment of young sets, whose ultimate destination is the forcing shed, is for the first two years similar to that of sets for outdoor pulling. If the roots are to remain out of doors for three years or longer, light pulling of the natural sticks may be taken during the second year, but as a rule it is not profitable to take more than two pullings, save in exceptional cases where the demand for outdoor rhubarb is such as to ensure a return that will enable some extra manuring to be done.

During the year preceding forcing, farmyard manure up to 15 tons to the acre, together with 4 cwt. superphosphate, should be applied in all cases. The crop should not be pulled, the stalks being allowed to die down. Any which show signs of

flowering should be bent over or cut back above a node, so that water may not run down and collect in the crown and promote rotting. If the flower-head is cut off, the cut should be made in a slanting direction, as this minimizes any risk of water getting inside the stem.

Varieties.—All varieties which are commonly cultivated do do not respond equally well to forcing, and, in common with most crops, the varieties display differences in cropping capacity in different localities.

The two chief varieties for early forcing are *Dawes Champion* and *Prince Albert* (known also as *Royal Albert*). A third early variety which is popular with some growers is *Sutton's Seedless*.

Dawe's Champion.—This is a robust grower, of a good full colour, with pink tinged flesh.

Prince Albert.—A very early variety, but it tends to be lacking in vigour, and is not so prolific as most other varieties.

Sutton's Seedless.—A strong grower, with an excellent flavour, and very prolific. It matures at the same time as *Prince Albert.* The flesh is pink tinged.

Victoria.—This is the standard variety. It is a little later than the foregoing varieties, but is unsurpassed for general merit, and the bulk of the rhubarb grown for forcing is of this variety.

Linnaeus.—This variety is not used to any great extent for forcing, though there are individual growers who regard it very favourably. It is a strong growing variety, and crops well.

Hawke's Champagne.—This variety is not cultivated largely in the north, but is a favourite variety in the London district. It does not respond at all well to forcing.

Propagation.—Where only the "natural" rhubarb is produced, the propagation of stock is simply a matter of sub-division of the old roots, in the manner described below.

On forced rhubarb farms, two methods of propagating stock are practised :—

(*a*) Under the first method, the practice is to plant out of doors the roots which have been forced during the previous winter. These roots are not sub-divided before planting, but are carted out from the forcing sheds and ploughed in, 18 in. apart in the rows, with 30 to 36 in. between the rows. The object of the close planting is to avoid blanks in the rows, the rows being thinned out to the normal distance as soon as the roots have fibred in.

This method of maintaining the supply of roots for forcing is not to be recommended. After being forced, the roots are deficient in vitality, are an easy prey to disease and insect pests, and do not produce the strong, vigorous crowns so essential for successful forcing. The practice of planting out such roots at only half the normal distance apart is, in itself, an admission of this fact. For small-scale production, where the roots can be given a certain amount of individual attention, the method doubtless succeeds, but to the large-scale producer of forced rhubarb it cannot be recommended as general practice.

(*b*) The second method of propagating stock consists of splitting up large stools, grown for this purpose in the open, into a number

of small sets, each having one strong bud and as much root as possible. When the roots are raised, it will be found that the most vigorous buds are on the outside. The operation of sub-division may be performed with a spade, or with a special chopper; as much "flesh" as possible should be left on each set, after any bruised or broken part has been cut away. The sets are then planted out as indicated above (section (*c*), page 647), and left to produce crowns suitable for forcing. This is by far the more satisfactory method, and produces the best results both as regards quality and vigour of the crop.

Where the latter method of propagation is followed, the well organized forcing farm will consist of the following sections:—

(1) What may be termed the *stock beds*, where roots are grown for sub-division. Each of these must be large enough to supply sufficient young sets to take the place of the roots lifted for forcing.

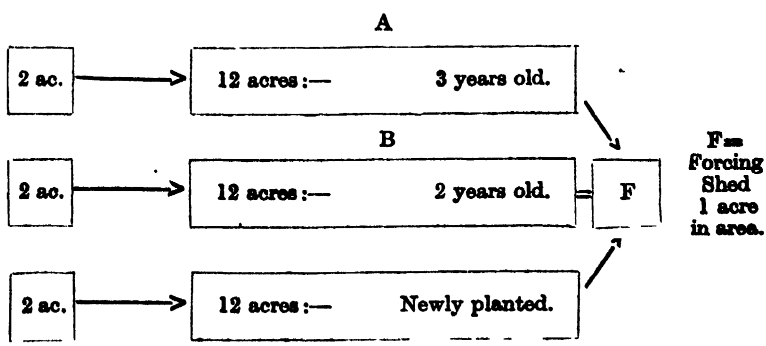
(2) Larger areas, planted out with sets, whose ultimate destination is the forcing shed.

(3) The *forcing sheds*.

(4) Wherever possible, enough land under other crops to enable some sort of rotation to be followed, so that each part of the rhubarb land shall periodically have a rest from the crop. This last is not the least important of the points connected with the hygienic cultivation of rhubarb.

For practical purposes, the ratio of the acreage under rhubarb in the open to the acreage occupied by the forcing sheds is about 12 to 1. That is to say, to fill 1 acre of forcing shed space with crowns these have to be lifted from 12 acres planted as described above. Therefore, where a grower has, say, 1 acre of forcing shed accommodation, and where he makes a practice of forcing after the roots have grown three years in the open, he will require to have 36 acres under young roots, *i.e.* 12 acres of one-year-old roots, 12 acres of two-year-old roots, and 12 acres of three-year-old roots, in addition to a further 6 acres under roots kept solely for stock.

To maintain a steady supply of roots for forcing, the area under roots, of all ages, in the open, must therefore be round about 40 times that of the forcing sheds. The following rough diagram will make these figures more readily intelligible:—



The mature stools from the Stock Bed " a " are sub-divided and planted out in " A," sufficient buds being retained to plant out the bed " a," or an equivalent area, again. The following year " B " is planted out by sub-division of the stock from " b " and so on.

Forcing Sheds.—Where forcing is to be done on a large scale, the forcing sheds should be situated centrally to the land under rhubarb, water should be laid on to the sheds, and a hot-water heating system should be installed. On many of the older-established farms heating is done by means of a stove, or an open fire, placed at the lower end of the shed. From the fire, earthenware flue pipes of about 12 in. in diameter are led throughout the length of the shed. Heating by hot-water pipes is, however, gaining in favour, and where new sheds are to be constructed, this system should be adopted.

The best type of house should be some 25 ft. to 30 ft. wide, with side walls of brick or concrete, about 2 ft. high, and a light double-span roof arching to a height of about 10 ft. This will allow of the entry of a horse and cart into the shed, required at the beginning and the end of the forcing season. Four-inch hot-water pipes should be hung at a height of 2 ft. from the floor. The sides and ends of the house may be of brick or of timber, and the roof should be of light timber, covered by a felting material. Houses of this type can be economically heated, and by reason of their moderate capacity a range of such houses makes it much easier for a grower to secure a succession of marketable produce throughout the season.

Filling the Sheds.—Crowns for forcing may be lifted by spade, but the method is slow and laborious, and the crowns are generally ploughed out. This work may be done any time after growth has ceased, but it can be performed most expeditiously during slight frost, and November or early December is, as a rule, the best time for the operation. The roots will respond much more generously to the forcing process if subjected to frost while dormant. Millard says, in this connection : " With rhubarb it would seem that, after growth has ceased, a period follows in which the plants mature or ripen, and not until this ripening process has gone its full course may the stocks be lifted for forcing. The sooner, therefore, the crop dies down, the sooner will it be ready for the forcing house. . . . The exact time of ripening depends on the maturity of the roots, and this in turn depends on the weather. . . .

So vital, however, are the processes which occur during the maturation period that roots, lifted a week too soon, may be worthless for the forcing shed."

In the work of filling the sheds, specially designed low trolleys are used in most cases. No special treatment of the crowns is required before they are placed in position in the forcing sheds, beyond cutting away any fanged roots to permit of close packing in beds. After packing the crowns in the beds, all the interstices between the roots should be filled with fine soil, to aid in the retention of moisture.

A central passage, about 3 ft. wide, should be left down the centre of each house. The roots should be tightly packed in beds along each side of this central pathway, each bed being 5 ft. to 6 ft. wide, with a narrow passage of 10 in. between the beds. With such an arrangement every growing stalk can be reached from a pathway, and the danger of breaking off the stalks is minimized. A further advantage is that the handling of the produce is reduced to a minimum.

Treatment during the Forcing Period.—The most important factors in growing forced rhubarb are the supplies of heat and of moisture. No ventilation is required, beyond what is given when the doors are opened for entrance and egress.

In the first week, the temperature of the forcing shed should not be below 40° F. nor above 45° F. During the second week, the temperature should be raised to 50° F. and it should be gradually raised to 60° F. as the crop gets stronger. At no time should this last temperature be exceeded if colour and firmness are to be secured, and particular care must be taken in this direction during the last week before pulling.

Watering is most conveniently done from taps inside the sheds. A hose with a fine spray nozzle should be used. Opinions differ as to how often, and in what quantity, water should be given. On some farms, the crowns are soaked once a week, while on others a light spray is given every second day. The beds should be kept moist but not sodden, and a moderate spraying every two days is to be preferred to drenching once a week. Heavy watering is as bad for ruining colour as is overheating. The crop should be ready for a first pulling one month after the commencement of heating.

Care during Harvesting.—The work of pulling the crop is of a delicate nature suitable for women and girls, who with a little tuition soon become expert. Care has to be taken that the

stalk is pulled away from the crown cleanly, and that the delicate skin is not broken. At the first pulling, the largest and firmest stalks should be picked, and all weak, attenuated, or discoloured stalks should be removed from the beds. Stalks must never be broken off, but should be slipped free from the ochrea, or sheath, by the thumb or forefinger, as, apart from the fact that broken stalks do not present an attractive appearance for market, the broken base of the stalk hinders the progress of the new bud. If the crowns are required for planting out in the spring for propagating purposes, they should not be stripped too severely, but if they are not so required, pulling may continue as long as it is economical.

Marketing.—There is no standard way of marketing rhubarb from the open. In the London district the sticks are either tied in bundles weighing 5 lb. to 8 lb., by means of willow rods—the sticks being alternately reversed at back and front—or they are packed loose in boxes holding some 30 lb. Elsewhere, field rhubarb is made up in bundles of 14 lb. and 28 lb. weight. The bundles are secured by ties of strong twine or hay, and no special precautions are taken in packing for transit, the bundles being merely built up, one on top of the other, in the vehicles used for conveyance to market.

Forced rhubarb, on the other hand, must be protected from rough usage in transit, freshness and attractiveness being essential features for ready sale. In the Yorkshire area, the rhubarb is made up in bundles of from 6 oz. to 12 oz. in weight, the size of the bundle being apparently fixed by each grower in a somewhat haphazard fashion. An attempt is being made by some growers to standardize the bundle at 8 oz., but the matter of standardization is one of great difficulty, owing to the great variations in size and thickness between varieties, and even between sticks of any one variety. In the case of *Victoria*, for example, a single well-grown stick will weigh more than 8 oz., and it is usual for the first few pullings of this variety to be marketed in single sticks, six dozen sticks being packed in each hamper.

No standard package is used in marketing the crop, and baskets, orange boxes and onion crates, with the central partitions removed, are commonly used, six dozen bundles being packed in each. The bundles are tied by hand, or by means of a special machine of simple and inexpensive design. Two ties of soft twine are made. An expert worker can tie 15 dozen bundles per hour by hand, while with the aid of the machine 70 dozen bundles per hour can be tied.

In the Glasgow area, forced rhubarb is marketed on similar lines, but the weight of the bundle there is 7 lb., while the smaller sticks, or seconds, are made up in bundles of 3½ lb. These latter find a ready sale among bakers and confectioners.

The chief markets for forced rhubarb are London, Liverpool, Sheffield, Manchester, Birmingham and Glasgow.

Weight of Crop.—The weight of forced rhubarb to be obtained from an acre of roots varies greatly, according to variety, age of the roots when forced, treatment during their growth in the open, and other factors. The following table gives, in round figures, details of the return under two different systems of management :—

A.—Variety *Victoria*: Allowed five years in the open before forcing, and no crop taken during the year prior to forcing.

B.—Variety *Victoria*: Allowed three years in the open before forcing, and outside crop pulled once in the year prior to forcing.

	Acreage of roots raised annually for forcing	*Average age of roots when forced*	*Weight of forced rhubarb marketed*	*Weight of crop per acre occupied by roots in the open*
	Acres	*Years*	*tons*	*tons*
A	15	5	240	16
B	6	3	80	13·3

In neither of the above cases were forced roots planted out again for stock. Forced roots which are not to be planted out may be heaped up in layers with quicklime, and left to crumble down ; the resulting compost makes a useful top-dressing.

Diseases and Pests.—The most important disease of rhubarb is that known as "Crown Rot" or simply as " Rhubarb Disease." It is a bacterial trouble, and the organism which causes it has been named *Bacterium Rhaponticum* by Mr. W. A. Millard,* who has carefully studied the disease. In infected crowns the bases of the sheaths and of the stalks become swollen, the leaves become puce-coloured, whilst the crown itself succumbs to a soft brown rot. The terminal bud is destroyed and only spindly " sticks," derived from lateral buds, develop.

Infection takes place from the soil, and the disease occurs in plants grown in the open as well as in forced crowns. Experiments in soil disinfection have shown that watering with a solution of ammonia is a promising remedial measure, but further work is required before such treatment can be looked upon as a practical proposition. Proper rotation of crops and

* The University of Leeds and the Yorkshire Council for Agricultural Education : Bulletin No. 134, 1924, price 7d., post free.

"clean farming," with strict attention to the principles of sound plant hygiene, are the best methods of avoiding the disease.

The disease does not occur in Lanarkshire, where the following rules are observed in the cultivation of the crop :—

(*a*) A rotation of cropping is practised.
(*b*) Lime is used liberally.
(*c*) Forced roots are seldom, if ever, replanted for stock.
(*d*) Manures of doubtful nature, such as town refuse, are seldom used.

Some damage is occasionally done to the crop by eelworms, especially where forced roots have been used for stock purposes.

OCTOBER ON THE FARM

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Seasonal Operations.—October is the first month of the arable farm year and ordinarily it is a busy period. After the necessary stubble cultivations and manurings have been completed—or carried as far as weather conditions permit—autumn seeding operations follow, October being the favourite month for drilling winter oats (black and grey varieties), barley (six row and Archer varieties), beans, wheat, and mixed grains for ensilage, for hay or for thrashing.

The following is a typical silage mixture : 6 stones winter tares, and 6 stones black winter oats per acre. Where it is desired to include beans, these should be ploughed in about 4 in. deep two or three weeks before the tares and oats are drilled, otherwise the beans are apt to be repressed by the latter : 4 stones beans may replace 2 stones tares. For mixed grain—which Mr. J. C. Brown advocates on the grounds that it yields appreciably heavier crops than single grains, keeps the land clean and saves the cost of ensilage—the mixture recommended is 6 stones beans, 3 stones tares, 2 stones oats and 2½ stones barley per acre.

Many beds of maiden seeds are this year too forward in development and probably will not winter well unless grazed back before the end of the month. At Garforth (Yorks) grazing off with sheep, followed by a dressing of ground lime (in which Garforth soils are deficient) resulted in an improved stand of red clover in the following year.

Owing to the prevalence of blight in potatoes, special

precautions in storing the crop will be advisable, not only on account of the expected high value of the tubers, but also because of the liability to decay unless pitted in dry condition. Special comments on potato storing appeared in these notes last October.

Bullocks, purchased for winter feeding, are now brought into the yards and enter upon the first stage of the fattening process. In addition to their daily allowance of straw and turnips—chiefly whites and yellows in this month—they receive a small ration of concentrates, not exceeding about 4 lb. per head per day at first. The use of large quantities of linseed and cotton cakes is still common but out-of-date practice. Fattening hoggs are also introduced to the turnip fold, commencing with white varieties, but care is necessary to prevent digestive troubles in the change to watery rations. and the recognised safeguard is a liberal allowance of hay. Here, as with bullock feeding, modern ideas are against the use of large quantities of protein-rich cake for fattening purposes.

Early lambing flocks of ewes are already in lamb, but October is the usual time for turning in the rams where lambs are not desired before March. It is an accepted principle that the ewes at this time should be in improving but not fat condition, which is ensured by providing better keep. "Flushing," as the practice is termed, increases the number of lambs.

On the pastoral farm, October marks the approach of the end of the grazing season, for after this month grass makes little growth, and only such keep as the summer stock have left uneaten is available. Opinions differ as to whether it is better to allow store stock to bare the fields off in winter or to keep the fields clear until early spring, when the old and the new may be pulled off together. On rich land inclined to cause scouring, the latter is probably advisable ; but on poorer soils with an inclination to become matted, no opportunity of baring the ground should be missed.

Dairy cows in milk now require practically full "winter rations," *i.e.* typically, 3½ lb. concentrates per gallon of milk yielded or anticipated—and an increasing allowance of hay and cabbage or kale as the days shorten. Between the middle and the end of the month—according to weather conditions and the state of the gateways—the herd ceases to go out after the evening milking, but at this juncture it is important to keep the sheds cool and well ventilated so that the cows gradually harden off before winter conditions set in. A correspondent from a south-western county informs me that last

winter he kept one of his herds entirely out of doors and the cows milked well and maintained their condition to his entire satisfaction. In the Midlands, dry cows and strong young stock are known to fare well out of doors all winter; but it is probably only in the milder counties where out-wintering could be practised with reasonable success with cows in milk.

Cowsheds.—While it is not impossible to produce clean milk in an unsuitable byre, the first essential—clean cows—is attained with less difficulty when the floor of the shed may be swilled out, and when the "standing" or platform and the manure channel are designed to prevent the cow's feet, tail and hindquarters from becoming soiled.

Many farmers labour under considerable handicap in respect of their cowsheds, and for various reasons much expenditure will, during the next few years, be incurred in effecting alterations. Unfortunately there is in some districts widespread prejudice against some of the essential features of an improved cow-stall. Concrete floors are believed to be necessarily slippery and prone to cause udder chills and big knees; and the high, short "standing" is regarded as dangerous in a number of ways. Consequently, when alterations are made it not infrequently happens that obsolete ideas prevail, errors are repeated and money is spent without attaining the permanent improvement that is possible.

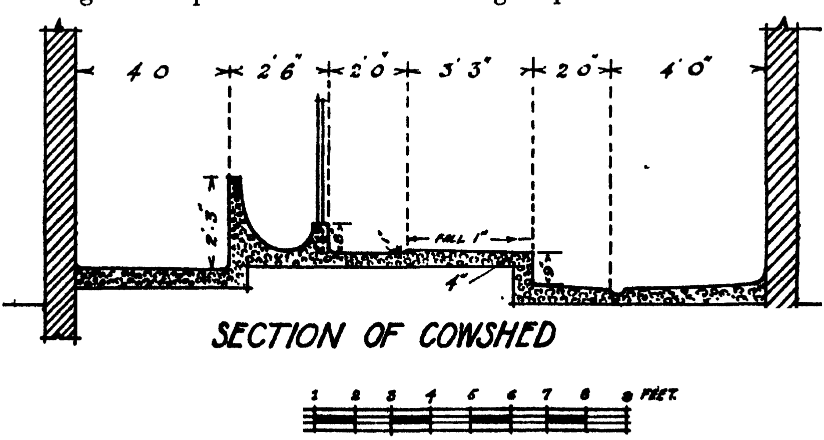
The accompanying illustration represents a section through a cowshed floor, designed in accordance with the writer's experience of shed alterations in Derbyshire, where in recent years a number of byres have been re-floored under his guidance. In many respects the floor is similar to that described and illustrated in the Ministry's pamphlet, "The Construction of Cowhouses," but there are two differences which by some are thought to be improvements. The first is the absence of a curb behind the manure channel.* This facilitates cleaning out and is safer for the cows to cross when going in and out of the shed. The second is the depression one inch deep extending two feet from the near edge of the manger. This is to hold litter and prevents the big knee trouble which has been already mentioned as one of the criticisms of concrete floors.

* NOTE.—On the other hand, the absence of a back curb permits splashing of both solid and liquid excreta, which is not conducive to cleanliness, but Mr. Bond feels that the rear curb and the raised hinder walk cause or permit reflection of splashes on to the platform, and that in narrow sheds with little room behind the cows—a circumstance too common—the absence of a back curb is a great convenience to the attendants.

The entire floor is made of concrete, roughened with a broom before setting. Hitherto the hinder passage and the rear portion of the standing have been grooved, but it is doubtful whether with a roughened surface the grooving serves any useful purpose. As regards mangers, glazed half-pipes are undoubtedly the best, but whatever kind of manger is used it is essential that the bottom be an inch or two higher than the level of the standing, otherwise the cows will move forward when eating.

The widths of the front and hinder walks are variable, according to the space available, but for ordinary cows of Shorthorn size, the other dimensions may not be varied without special reasons. The case here assumed is that of a stall without a hay rack in front and where the cows are tied to a side stay fixed opposite the middle of the near lip of the manger. Where stanchions are fitted the standings may be about three inches shorter. Generally it is advantageous to grade the length of the standings from 5 ft. at one end of the shed to 5 ft. 6 in. at the other end, to accommodate small and large cows respectively.

Perhaps the most contentious matter is that of the height of the platform above the level of the manure channel. The object of a high standing is firstly to discourage the habit of the cows to stand with their hinder feet in the grip, as a result of which they soil the platform when they stand up and sometimes they contract "foul in the foot" from continuous contact with manure. A second advantage of the high standing is that it keeps the cow's tail clean, when she lies down. The objection commonly raised against it is that cows have been known to injure themselves by slipping off it. This is possibly due to the fact that sometimes the error is committed of rounding the edge of the platform instead of leaving it square. I have heard



SECTION OF COWSHED

of cases where farmers have had the grips filled in again to reduce the height of the standing, but in my experience that has never been the case. Indeed, one farmer who has re-floored five sheds during the past four years, has successively increased the height of the platform until in the last-altered shed he has made it on the average 12 ins. above the bottom of the grip.

The cost of re-flooring a byre varies according to the dimensions per cow. Frequently it is not necessary to alter the fore-passage or the mangers. Where the alterations are confined to the standing, the grip and the hinder walk, the cost of putting in a floor similar to that illustrated in the sketch is about £2 per cow.

NOTES ON MANURES FOR OCTOBER

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Autumn Manuring.—In October the arable land will receive most attention, the manurial treatment of the permanent grass being left till a little later in the year. Thorough incorporation with the soil is a factor in the success of fertiliser treatment, and it is desirable that autumn-sown crops should have their phosphates applied before drilling so that the cultivations necessary to finish the seed bed and cover the seed may also serve the purpose of working in the manure. This is all the more necessary for phosphates such as basic slags and steamed bone flour which are not water soluble. On such heavy or medium soils as are known to respond to potash, the potash manures may well be given with the phosphates for autumn-sown crops. The case of nitrogenous fertilisers is rather different. On free draining soils the loss of nitrate in the wet winter months when little growth is taking place may be considerable, especially if quick-acting nitrogenous manures are applied. Even dressings of farmyard manure are not free from this objection, although the convenience of being able to get the dung out at this time of the year outweighs any loss of nitrate which may occur. On the other hand organic manures such as shoddy, feathers, sewage sludge and town refuse can be given in autumn since their decomposition in the soil is a rather slow process.

In deciding the dressings to apply to autumn-sown crops the previous treatment of the field will be the main guide.

Those following early lifted roots or potatoes which have been "well done," will scarcely need a further supply of phosphate; but autumn corn after seeds or after a straw crop will usually benefit from a dressing of about 2 cwt. per acre of superphosphate, or its equivalent of basic slag or steamed bone flour. The need for potash depends on similar considerations, but the lighter the soil and the longer the interval since the land last received farmyard manure the more likely is it that potash manures will be required. Where potash is wanted a dressing of ½ to 1 cwt. per acre of muriate of potash or the equivalent quantities of 20 per cent. or 30 per cent. potash salts should suffice.

Beans, vetches, and silage mixtures may be treated as outlined above, but when these crops are grown in heavy land, the phosphate might be slightly increased and the potash omitted.

As far as the sugar beet area is concerned it is considered good practice to apply the dung in autumn or winter and turn it in with a deep furrow. Spring applications of farmyard manure are liable to produce fangy roots which carry a large amount of soil to the factory. Like the potato, sugar beet is a crop which does best with a supply of dung. Very heavy dressings are not necessary, however, for it has been repeatedly shown that a moderate dressing of about 12 tons per acre of farmyard manure, supplemented by a complete mixture of artificials in the spring, will produce satisfactory crops.

Comparative Costs of Limes.—When it has been decided that a field is to receive a dressing of lime or of chalk, the question arises as to what is the cheapest form available. Several factors enter into this matter :—

(1) The cost per ton on rail of each of the alternatives.

(2) The carriage per ton from the place of origin to the farmer's station. (Often these two items are brought together in a quotation of so much per ton delivered to nearest station.)

(3) The lime content of the materials. This may be ascertained by having an analysis made of a carefully taken sample, unless it is stated by the vendors. If the analysis states the percentage of calcium carbonate as in chalk or limestone, this can be converted into the equivalent quantity of quicklime by multiplying by the factor ·56.

When these figures are ascertained for such lime products as may be regarded as alternatives for the purpose in view—and for most purposes ground lime, ground chalk, hydrate of lime, and ground limestone fall in such a class—a simple calculation will show what 1 ton of pure lime (CaO) costs on the farm, when purchased in any of the alternative forms. The substance which yields the lowest figure in this way will be the cheapest form of lime product to buy.

If lump lime is to be compared with any of the substances mentioned above, an addition to its price should be made for the estimated cost of slaking the lime on the farm, in order to reduce it to a sowable condition.

Lump chalk can hardly be valued this way, since owing to its coarseness, only a small fraction of the total dressing can be expected to come into action in the years immediately following its application.

Before undertaking an improvement which may cost from £2 to £4 per acre it is advisable to consult the County Agricultural Organiser. It is usually possible in cases of doubt to arrange to have a soil analysis carried out, on the results of which, when interpreted in the light of local experience, a sound course of action can be recommended. Cases have occurred where farmers have proposed to give a dressing of lime to soils, which on examination, have been found to be well supplied with this constituent.

Cyanamide.—Another source of nitrogen has recently been made available to British farmers in the form of cyanamide. This fertiliser is by no means a new one. It has been manufactured on a large and increasing scale since 1905, and a certain amount was used in England before the war. In Germany in 1922, cyanamide accounted for about one-fifth by weight of all the nitrogenous artificials used.

Cyanamide is made by a process of fixation of atmospheric nitrogen whereby purified nitrogen is caused to combine with calcium carbide at a high temperature. The product as originally turned out was excessively dusty, but means have been devised to combat this. Cyanamide contains about 19 per cent. of nitrogen in the form of calcium cyanamide, and up to 60 per cent. of lime, of which approximately one-third is present as free lime, the remainder being combined with the nitrogen. In the soil the nitrogen is transformed by a series of changes into compounds which the plant can utilise.

Urea is first formed by a chemical action, after which ammonia and eventually nitrate are produced by the agency of bacteria. This process takes place most rapidly in fertile soils in good physical condition, and in any case requires some time to complete, so that cyanamide is one of the slower acting nitrogenous manures. The lime is ultimately converted into chalk, each hundredweight of cyanamide thus providing rather less than an equal weight of chalk; but although this action undoubtedly helps to maintain the chalk supply, the use of cyanamide cannot be regarded as a substitute for liming on acid soils.

As far as the manurial value of cyanamide is concerned, more experimental work has been carried out on the Continent than in England. Most experimenters are agreed in assigning to the nitrogen of cyanamide a slightly lower effectiveness than the nitrogen of nitrate of soda or sulphate of ammonia. Moreover, when tried over a large range of soils and agricultural conditions, cyanamide has shown more variability of performance than the other two forms of nitrogen. On the other hand its present price of 9s. 9d. per unit is lower than that of the above mentioned fertilisers.

Cyanamide is best used fresh and, on the arable land, it is more suitable for incorporation in the seed bed than for top dressings. It should be applied some time before sowing, a good rule being to allow one week in the soil for each hundredweight per acre given. The quantities used per acre are about the same as in the case of sulphate of ammonia.

On the more retentive soils on the Continent, cyanamide is often applied with good effect before drilling winter corn, but this practice has not as yet been extensively tested in this country.

Fertiliser Prices.—The present time is one of low prices of agricultural produce as compared with commodities in general, and attention naturally turns to an examination of the production costs of our farm crops. It is interesting to note that the price of artificial manures is one of the items in the cost of crop production which shows a relatively small increase above pre-war levels. In a recent issue of the Agricultural Market Report, the percentage increase of fertiliser prices above the rates prevailing in the years 1911-13 are given as follows, the latest figures referring to the month of July, 1926: Nitrate of Soda + 25 per cent; Sulphate of Ammonia — 16 per cent. (decrease); Basic slag (30 per cent. quality) +

46 per cent.; Superphosphate + 15 per cent.; Kainit + 12 per cent. It will be seen that in most cases the increases above pre-war prices are very moderate, and sulphate of ammonia is cheaper now than it was before the war. Up to the time of writing the only marked change which has occurred in the prices of the above artificial manures has been a reduction in the price of sulphate of ammonia.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named and are net cash for prompt delivery.

Description	Average price per ton during week ending September 8.				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	13 10	13 0	12 10	12 15	16 5
„ lime (N. 13%) ..	..	12 10	..	12 7‡	19 0
Sulphate of ammonia—					
Neutral (N. 21·1%)	11 7*	11 7*	11 7*	11 7*	(N)11 0
Kainit (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	3 12	3 0	3 9	3 3	3 2
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51½%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 38%)	..	..	..	..	..
„ (T.P. 36%)	..	..	..	..	..
„ (T.P. 34%)	..	..	3 8§	3 11§	2 1
„ (T.P. 30%)	..	3 2§	8 3§	3 6§	2 2
„ (T.P. 28%)	..	2 11§	..	..	..
„ (T.P. 26%)	..	2 7§	..	..	..
„ (T.P. 24%)	..	2 2§	2 3§	2 11§	2 1
Ground rock phosphate (T.P. 58%)	2 10¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 9	3 5	1 10
„ (S.P. 33%) ..	..	..	3 6	..	..
„ (S.P. 30%) ..	3 0	2 10	3 2	2 18	1 11
Bone meal (N. 3¾%, T.P. 45%) ..	8 10	8 5	8 10	..	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 0†	6 10†	5 15	5 10	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate: Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ Delivered in the home counties.

§ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton.

MONTHLY NOTES ON FEEDING STUFFS

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Influence of the Crude Fibre of Feeding Stuffs on their Digestibility.—If any feeding stuffs commonly used for stock be boiled with dilute acid or alkali, the bulk of the feeding stuff becomes dissolved, but an insoluble portion is generally left. This insoluble residue is called "woody" fibre, and is mainly composed of cellulose. This substance resists solution, and is a common constituent of most plants, being used for the building up of their supporting framework. It is, consequently, most prevalent in the stems of plants and least so in the fruits. The digestive juices of animals are not able to dissolve cellulose, since there is no cellulose-digesting ferment present in them. Indeed, in the animal kingdom, the snail is the only creature in which a cellulose-digesting ferment has been found. The woody fibre of feeding stuffs is, therefore, not of much value except that it adds bulk to the ration and gives the animal a full, contented feeling.

To what extent, then, does woody fibre occur in common feeding stuffs? In oilcakes, the woody fibre fluctuates from 4½ per cent. to nearly 30 per cent., according to the type of seed used and to whether the seed has been decorticated or not prior to crushing; a similar variation being shown in the case of brewery and distillery by-products. Milling by-products show a fluctuation of from 4½ per cent. to nearly 60 per cent.; the common milling by-products, such as wheat and barley bran, containing about 8 per cent. of woody fibre. Oilseeds vary from 5½ per cent. in the case of linseed to 28 per cent. in the case of sunflower seed. The common leguminous seeds, peas, beans, lentils, soy beans and vetches, are characterised by a low woody fibre content, ranging from 3½ per cent. to 7 per cent. The cereal grains are fairly low in woody fibre, varying from 1½ per cent. in the case of wheat to from 8 to 15 per cent. in the case of oats. Roots are very low in woody fibre, chiefly because of their watery nature, the percentage of woody fibre in their case rarely exceeding 1½ per cent. Green fodders are also comparatively low in woody fibre and generally fluctuate between 3 and 10 per cent. In coming to hays, we find a jump in fibre content, the woody fibre varying from 20 per cent. in the case of excellent meadow hay to over 30 per cent. in the case of poor meadow hay. In the case of straw, the fibre content is very high, averaging about 40 per cent.

If we now consider the digestibility of these feeding stuffs, we find that, considered broadly, it varies inversely with the

woody fibre content; feeding stuffs containing little or no woody fibre showing high digestibility, and those containing much of this fibre showing low digestibility. Thus the digestibility of milk by ruminants is 98 per cent., whereas earthnut cake is 83 per cent., meadow hay 61 per cent., and straw 42 per cent. We can therefore accept the general rule that the higher the percentage of woody fibre there is in a feeding stuff, the less digestible it becomes. Moreover, another factor comes into play, *i.e.*, the depressant effect of the woody fibre varies according to the species of animal. Thus the digestibility of milk or meatmeal, used for pigs, sheep, cattle and horses, is, approximately, the same for all, showing that, in the absence of woody fibre, the digestive apparatus of all these animals is equally efficient. When we compare feeding stuffs containing woody fibre, we find divergency occurring in the different animals. Thus sheep and cattle digest 61 per cent. of meadow hay, horses 50 per cent., and pigs practically none. Horses, sheep and cattle digest barley to the extent of 86 per cent., pigs to the extent of 81 per cent. The reason for these differences may be sought in the relative anatomical differences met with in the digestive apparatuses of these different animals.

If the food residues obtained from horses and ruminants be examined, it will be found that the crude fibre has, to a certain extent, disappeared during its passage through the digestive tract, and it has been demonstrated that this apparent digestion of crude fibre by ruminants and horses is due to the action of bacteria and other lowly-organised forms of life. Thus with ruminants, the woody fibre of hay shows an apparent digestibility of 59 per cent., and in horses of 39 per cent. In the case of barley, the woody fibre is apparently digested to the extent of 100 per cent. by ruminants and horses, and only to the extent of 12 per cent. by pigs. The depressant effect of the presence of woody fibre in a feeding stuff, consequently, exerts its maximum effect on pigs, is much less effective with horses, and has least effect with ruminants. Anatomical and physiological considerations support this view. The sheep and cow have a very capacious digestive apparatus, and by means of the four-chambered stomach and by chewing the cud, grind the woody fibre to a very fine state. The horse does not possess a capacious stomach, and does not chew the cud; but these deficiencies are, to a considerable extent, compensated for by the enormous development of the large intestine. The pig, on the other hand, possesses neither of these advantages. We have seen, then, that woody fibre in a feeding stuff exerts considerable influence on its digestibility.

What are the practical lessons to be drawn from this knowledge? Firstly, food for pigs should always be chosen from those possessing a low fibre content. Secondly, horses should only be fed with very fibrous feeding stuffs when in a resting condition. As soon as heavy work is required, the cereal ration and concentrated foods used need to be increased, and the quality of the fibrous foods given should be improved. The same principle holds good, also, in the case of ruminants, where rapid fattening or the production of large quantities of milk is desired. Thirdly, in the production of hay for feeding to one's own stock, quality rather than quantity should be the primary consideration. Leaving hay until the last moment before cutting increases the quantity but also increases the percentage of woody fibre present.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch equivalent	Protein equivalent	Per ton £	s.
Barley (imported)	71	6·2	8	15
Maize	81	6·8	8	12
Decorticated ground nut cake	73	41·0	11	10
,, cotton cake	71	34·0	10	0

Add 10s. per ton, in each case, for carriage. The cost per unit starch equivalent works out at 2·27 shillings, and per unit protein equivalent, 1·64 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organisers and other advisers in connection with advisory schemes on the rationing of dairy cows. are given in the November, 1925, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	8 19
Oats	60	7·6	7 9
Barley	71	6·2	8 11
Potatoes	18	0·6	2 2
Swedes	7	0·7	0 17
Mangolds	7	0·4	0 16
Beans	66	20·0	9 3
Good meadow hay	31	4·6	3 18
Good oat straw	17	0·9	2 0
Good clover hay	32	7·0	4 4
Vetch and oat silage	13	1·6	1 12
Barley straw	19	0·7	2 4
Wheat straw	11	0·1	1 5
Bean straw	19	1·7	2 6

DESCRIPTION	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British..	—	—	12 10‡	0 14	11 16	72	3 3	1·74	9·6
Barley, British feeding ..	—	—	8 10‡	0 11	7 19	71	2 3	1·20	6·2
„ Canadian No. 4 Western	31 9	400	8 18	0 11	8 7	71	2 4	1·25	6·2
„ American	31 9	„	8 18	0 11	8 7	71	2 4	1·25	6·2
„ Russian	30 9	„	8 12	0 11	8 1	71	2 3	1·20	6·2
Oats, English, white	—	—	9 7‡	0 12	8 15	60	2 11	1·56	7·6
„ „ black and grey	—	—	8 10‡	0 12	7 18	60	2 8	1·43	7·6
„ Canadian No. 2 Western	28 3	320	9 18	0 12	9 6	60	3 1	1·65	7·6
„ „ No. 3 „ ..	27 0	„	9 8	0 12	8 16	60	2 11	1·56	7·6
„ „ feed	25 3	„	8 17	0 12	8 5	60	2 9	1·47	7·6
„ American	25 0	„	8 15	0 12	8 3	60	2 9	1·47	7·6
„ Argentine	24 3	„	8 10	0 12	7 18	60	2 8	1·43	7·6
„ Chilian	24 3	„	8 10	0 12	7 18	60	2 8	1·43	7·6
Maize, Argentine	34 9	480	8 2	0 11	7 11	81	1 10	0 98	6·8
„ South African	39 3	„	9 3†	0 11	8 12	81	2 1	1 12	6·8
Dari, Bombay	—	—	11 10	0 13	10 17	74	2 11	1·56	7·2
Rye, Home grown	—	—	8 0	0 14	7 6	72	2 0	1·07	9·1
Millers' offals—									
Bran, British	—	—	6 0	1 4	4 16	42	2 3	1·20	10
„ broad	—	—	6 15	1 4	5 11	42	2 8	1·43	10
Middlings, fine, imported ..	—	—	7 15	0 19	6 16	69	2 0	1·07	12
„ coarse, British ..	—	—	7 2	0 19	6 3	58	2 1	1·12	11
Pollards, imported	—	—	5 15	1 4	4 11	60	1 6	0·80	11
Meal, barley	—	—	10 2	0 11	9 11	71	2 8	1·43	6·2
„ maize	—	—	8 15	0 11	8 4	81	2 0	1·07	6·8
„ „ South African ..	—	—	8 17†	0 11	8 6	81	2 1	1·12	6·8
„ „ germ	—	—	8 0	0 17	7 3	85	1 8	0·89	10
„ „ gluten feed ..	—	—	8 7	1 3	7 4	76	1 11	1·03	19
„ locust bean	—	—	9 0	0 9	8 11	71	2 5	1·29	3·6
„ bean	—	—	12 0	1 8	10 12	66	3 3	1·74	20
„ fish	—	—	18 5	3 15	14 10	53	5 6	2·95	48
Maize, cooked flaked	—	—	10 17	0 11	10 6	85	2 5	1·29	8·6
Linseed—									
„ cake, English, 12% oil	—	—	12 12	1 13	10 19	74	3 0	1·61	25
„ „ „ 10% „	—	—	12 5	1 13	10 12	74	2 10	1·52	25
„ „ „ 9% „	—	—	12 0	1 13	10 7	74	2 8	1·43	25
Soya bean „ 6% „	—	—	12 0	2 7	9 13	69	2 10	1·52	36
Cottonseed cake, English, 5½%„	—	—	6 5	1 8	4 17	42	2 3	1·20	17
„ „ Egyptian, 5½% „	—	—	5 15	1 8	4 7	42	2 1	1·12	17
Decorticated cottonseed cake, 7% oil	—	—	10 0	2 7	7 13	71	2 2	1·16	34
Decorticated cottonseed meal, 7% oil	—	—	10 5	2 7	7 18	74	2 2	1·16	35
Coconut cake, 6% oil	—	—	8 15	1 7	7 8	79	1 10	0·98	16
Ground nut cake, 6% oil ..	—	—	7 12	1 12	6 0	57	2 1	1·12	27
Palm kernel cake, 6% oil ..	—	—	6 15	1 0	5 15	75	1 6	0·80	17
„ „ „ meal, 6% oil	—	—	7 5	1 0	6 5	75	1 8	0·89	17
„ „ meal, 2% oil ..	—	—	6 0	1 1	4 19	71	1 5	0·76	17
Feeding treacle..	—	—	5 15	0 9	5 6	51	2 1	1·12	2·7
Brewers' grains, Dried ale ..	—	—	6 12	1 1	5 11	49	2 3	1·20	13
„ „ „ porter ..	—	—	6 2	1 1	5 1	49	2 1	1·12	13
„ „ Wet ale ..	—	—	0 13	0 8	0 5	15	0 4	0·19	4·8
„ „ „ porter ..	—	—	0 10	0 8	0 2	15	0 2	0·09	4·8
Malt culms	—	—	7 0†	1 10	5 10	43	2 7	1·38	16

‡ New crop †At Liverpool

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of August and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 11s. 0d.; P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

MISCELLANEOUS NOTES

National Rat Week, 1926

THE week commencing Monday, November 1 next, has been selected for the annual "Rat Week" this year. As is well known, rats cause great loss to the country every year both directly, in the destruction of foodstuffs and materials, and indirectly, as the agents and carriers of disease germs; and it is only by continuous, systematic and determined action on the part of all occupiers of lands and premises, and by the local authorities, vested with powers and duties under the Rats and Mice (Destruction) Act, 1919, that this menace to the community's welfare can be effectively minimised.

The Ministry, in a circular letter to the local authorities concerned, asks for their whole-hearted co-operation and support in the special effort of this Rat Week towards ridding the country of these destructive rodents; and has outlined for their consideration various courses of action, all or any of which they are free to adopt, apart from any special measures they may consider specially suitable to their respective districts. Among other things, it is suggested that :—

(*a*) Special attention be given to rubbish tips, sewage farms, sewers or any other source of infestation within the authority's own control; also that owners of premises peculiarly liable to infestation by reason of the nature of the business carried on there, should be specially circularised.

(*b*) A publicity campaign should be instituted to call public attention to the special effort of Rat Week and the responsibilities imposed by the Act. Advertisements and articles in the local Press, the display of posters, special displays of raticides and rat traps by local tradesmen, are indicated in this connection. The use of the Ministry's cinematograph film on rat destruction at local cinemas, or the giving of the Ministry's lecture on "The Story of the Rat" (illustrated by lantern slides) in local halls, would afford other means of obtaining publicity and giving instruction. Both film and lecture can be obtained by local authorities on loan under certain conditions.

(*c*) Small village committees might be formed to draw up a plan of campaign in co-operation with the local authority's Rat Officer. Local rat clubs might be formed, where not already in existence, and funds collected to pay prizes for

the largest number of rats destroyed. Public funds cannot now be drawn upon for this purpose.

(*d*) As the Boy Scouts' Association has voluntarily offered its assistance to the Ministry in the Rat Week campaign, scoutmasters of the local troops should be asked to co-operate in the work.

Simple suggestions for rat destruction have been furnished to local authorities, which they are at liberty to reproduce for circulation in their districts. Single copies of the Ministry's Leaflet, No. 244, on "The Destruction of Rats," will be sent free to applicants; additional copies can be obtained at 1d. each, 9d. per dozen, or 4s. per hundred, post free. The Ministry is ready at any time to give all assistance or advice in its power where cases of rat infestation present features of special difficulty; and it will be glad to receive particulars of any matters of exceptional interest arising in connection with this year's Rat Week.

Stud Goat Scheme

UNDER this scheme, specially selected sires are provided for mating with the milch goats kept by smallholders, cottagers, etc., with the object of producing progeny of better milking capacity than is usual from the service of "scrub" sires. Last year 89 stud goats were registered for service under the scheme, and 1,115 services given. For the present breeding season, which began on 1st of September, 104 stud goats have been registered and are standing at 99 centres in various parts of the country. The services of these goats for breeding purposes are available at a nominal fee, in no case exceeding 5s., provided the owner of the milch goat is eligible under the scheme. As the number of stud goats is much greater this year than last, it is hoped that no smallholder or cottager who keeps milch goats will find any difficulty in taking advantage of the opportunity provided under the scheme, for mating his goat with a first-class sire. Conditions of service and other information may be obtained from the County Agricultural Organisers throughout England and Wales, at their respective County Education Offices, or from the Hon. Secretary of the British Goat Society, which is responsible for the administration of the scheme, at 10 Lloyd's Avenue, London, E.C. 3.

The De Vecchis Sugar Beet Process

IN the winter of 1924-5 the De Vecchis process for the manufacture of beet sugar was investigated on behalf of the Ministry by a technical Committee which visited Italy and reported on the matter to the Ministry.* The Committee stated that the process had scarcely emerged from the experimental stage, but the principles were sound, and that the improvements in the plant necessary to render it commercially successful ought to present little difficulty, and once these difficulties were overcome the process would offer great possibilities for the development of the sugar beet industry in this country. The Commission also recommend that the process should be investigated here, and that a definite decision as to the desirability of introducing the process into this country should await the results of these experiments. Later in 1925, an offer was received from Sir Charles Cottier, of the British and Irish rights in the process and an agreement was entered into under which the rights were assigned to the Ministry free of charge, and the Ministry undertook to promote further experimental work at the Institute of Agricultural Engineering, Oxford.**

Dr. B. J. Owen, Director of the Institute, has now furnished a progress report on his investigations which is published by H.M. Stationery Office as a White Paper.† This report is not a final one and is written, as far as possible, in non-technical language; at a later date a full technical report will be published. Dr. Owen states that a considerable amount of work had already been done by the Institute on the drying of vegetable materials,‡ and use has been made of this experience in dealing with the drying of sugar beet.

The Process.—The essential features of the De Vecchis process consist in (1) drying the beet in thin slices, (2) extracting the sugar from these dried slices by lixiviation instead of diffusion,§ and (3) purifying this concentrated extract before it is passed on to the normal methods of boiling down and crystallisation of the sugar.

* See this JOURNAL for April, 1925, p. 8.

** See this JOURNAL for February, 1926, p. 981.

† *Investigations into the Desiccation (De Vecchis) Process for Producing Sugar from Sugar Beet:* price 4d. net.

‡ See *Preliminary Report of an Investigation into the Artificial Drying of Crops in the Stack.* Institute of Agricultural Engineering, University of Oxford. Bulletin No. 2. The Clarendon Press, Oxford, price 2s. 6d.

§ Diffusion is the passing of a substance in solution into a solution of less concentration. Lixiviation is the separation of soluble from insoluble substances by the action of a solvent.

It is claimed that drying produces material that can be stored and worked up throughout the year, and in this way the extraction process need no longer be confined to the hundred days or so to which the diffusion treatment of the fresh beet is limited. A further claim is that drying, by rupturing the cells and coagulating the albuminoids, enables a more concentrated and purer extract to be obtained, without the employment of a large volume of water as in the diffusion process, and that the subsequent purification of this extract is simplified.

So far as drying the beet is concerned the practical requirement is that a quantity of water, amounting to approximately 75 per cent. of the total weight, must be removed. The main difficulty is to ensure that the drying is effected without causing caramelisation or inversion of the sugar present. The drying must consequently be accomplished as rapidly as possible without the use of very high temperatures. The De Vecchis system provides for two-stage drying, the bulk of the moisture being removed during the first stage which occupies about 100 minutes. The second stage of drying lasts for about two hours and is done with the object of coagulating the albuminoids. Dr. Owen's investigations have shown that it is not necessary to divide up the drying process in this way and that, so long as the temperature to which the dried, or practically dried, cossettes were exposed did not exceed 230° F., there was no formation of invert sugar or caramel. It was also found essential to remove the moisture quickly so that the material was not heated in a moist state for any appreciable length of time. The best results were obtained when the duration of drying was reduced to one hour or less.

Experiments are still in progress to ascertain the best conditions for storage. Some cossettes dried at Eynsham have now been stored for six months and their condition is quite satisfactory. Cossettes have been stored successfully in Italy for over a year.

Extraction of sugar from dried cossettes by lixiviation follows the same procedure as is adopted in the extraction of many vegetable materials and no difficulty was anticipated under this head with the experimental plant that was devised. Syrups of 50° Brix were obtained from cossettes dried for periods varying from 1 to 3½ hours. An experiment with disintegrated cossettes tended to show that still stronger syrups could be obtained in this way.

Experiments are in progress with the object of improving Dr. De Vecchis' method, and an endeavour is being made to standardise a process which can be used in an equally satisfactory manner with all classes and strengths of syrups without any material addition to plant or labour.

The further treatment of purified liquors follows normal commercial practice and does not call for further comment here.

Economic Considerations relating to Factory Production.— The main simplification in sugar production by the desiccation process arises from the fact that, in the lixiviation of dried cossettes, a juice is obtained which has a density of 50° Brix, whereas in the diffusion process the raw juice has a density of only about 16° Brix. In other words, the amount of liquid which has to be handled under the desiccation process is less than one-third of that which has to be handled in the diffusion process. As it is an essential in either process that this liquid be heated (the temperature required is the same in both processes), if follows that the quantity of heat required for lixiviation is only about one-third of that required for diffusion.

The quantity of water evaporated in the diffusion process is given by Dr. Owen as 2,356 lb. for each ton of raw beet and in the desiccation process as 2,091 lb. In the diffusion process, however, the bulk of the water is evaporated in multiple-effect evaporaters which afford a very economical means of evaporation and as a result the total consumption of coal is lower in the diffusion than in the desiccation process.

It is estimated that the unit capital cost of a complete factory with a drying and extraction plant sufficient for 25,000 tons of fresh beet a year would be £2 8s. 0d. per ton, and that a similar factory for 100,000 tons of fresh beet a year would be £1 15s. 0d. per ton.

In a 25,000-ton factory equipped for drying and extraction, the production cost, including all overhead and standing charges, but excluding the cost of beet, is estimated to be not more than 19s. 3d. per ton of fresh beet treated, and for a 100,000-ton factory not more than 15s. 2d. per ton of fresh beet treated. At an average extraction of 13·25 per cent. of sugar and omitting the cost of fresh beet, one ton of sugar should be produced for about £7 5s. 0d. and £5 14s. 5d. respectively. These figures are based on the assumption that the data obtained at the Eynsham Experimental Factory and in Italy can be applied to operations on a much larger scale.

The present investigation naturally suggests a comparison between the diffusion process and the desiccation process,

and Dr. Owen thinks it is desirable to guard against the possible conclusion that the success of the desiccation process, if established, would jeopardise the future of the factories at present operating the diffusion process. The Progress Report shows that a substantial portion of the plant required is common to both systems. If it were decided to adapt a diffusion process factory in whole, or in part, to the desiccation process, additional items of plant would be required; and if the two systems were operated in the same factory at different times of the year some outlay would be necessary for making arrangements for cutting out temporarily, the sections of the diffusion plant not required for the desiccation process.

Details of the capital expenditure and of the production costs of factories working on the desiccation process, as well as some of the results obtained in the laboratory and at the Eynsham Factory, are given in Appendices to the Report.

Growers' Equipment.—In conveying fresh beet from field to factory, expenditure is incurred in respect of the water in the beet and the soil adhering to the roots; the water accounts for some 75 per cent. of the weight of the beet and the soil is also heavy; both these items would be eliminated by the new system. If the desiccation process is established in this country, Dr. Owen thinks that it should be possible to introduce a system of drying beet locally and so reduce the cost of transport from distant areas, either to the present diffusion factories, or to other central factories. In anticipation of developments on these lines, the Institute proposes to experiment further in devising suitable apparatus for cleaning, slicing and drying on the farm. Consideration will also be given to devising some inexpensive means of packing dried beet for various kinds of transport.

Patents.—It is desirable to add a few words of explanation regarding the patents governing the process. As already stated, the Ministry owns the British and Irish rights in the patents governing the original De Vecchis process. The property in any patents arising out of the experimental work in progress will also belong to the Ministry. The method referred to in the report as "mass-drying" is, however, governed by patents which are not the property of the Ministry. Should any company or person desire to operate the patents owned by the Ministry, application should be made to the Secretary. The granting of licences to operate any other patents which may be used in the production of beet sugar is not a matter with which the Ministry is concerned.

Nature of the Resistance of the Potato to Wart Disease

IN *Annals of Botany* for April this year Miss Katherine Cartwright describes an interesting investigation undertaken, at the suggestion of Professor V. H. Blackman, in the hope of throwing some light on the nature of immunity from wart disease exhibited by certain varieties of potato. The main object was to determine whether infection took place at all, and, if so, in what way the disease developed. An examination was made also of shoots of both immune and susceptible varieties in order to ascertain whether there were any differences, such as thickness of cuticle, wax formation, growth of hairs or any other feature which might form an obstacle. For this structural investigation three susceptible varieties (Arran Chief, Midlothian Early, and Ninety-Fold) and four immune varieties (Great Scot, Tinwald Perfection, Edzell Blue, and Kerr's Pink) were examined: but the results showed no anatomical difference between the young shoots of varieties of potatoes respectively immune from and susceptible to wart disease.

Parallel series of inoculations were made on an immune (Great Scot) and on a susceptible (Arran Chief) variety, care being taken that the conditions under which the two sets of inoculations were made should be as similar as possible. Rough experiments were also made to see if the temperature at which the tubers were kept had any effect on infection. For this purpose inoculations were made at temperatures from 78° to 80° F. and from 58° to 64° F., using in both cases potatoes sprouted in a cold room and also potatoes sprouted in an incubator. Changes of temperature, however, had very little effect on the degree of infection, infections being obtained at temperatures varying from 58° to 80° F. The healthiest tubers took the disease most readily, and the most satisfactory infections were made with tubers kept under normal conditions. As a result of the inoculation experiments, it was found that zoospores of the parasite are capable of penetrating the epidermal cells of young shoots even of the immune variety Great Scot. For the first two days the development of the organism seems normal: the organism increases in size and travels down the cell in the same manner as it does in susceptible varieties. After that time it becomes smaller and less definite in outline, showing signs of disorganisation; and appears finally to become dissolved and so disappears from the host-cell. It is evident that immunity from wart disease, at least in the variety Great Scot, does not depend on a capacity to

keep the invader out, but is mainly or wholly due to some physiological characteristic of the cells which render them unsuitable for the further development of the parasite. In the present state of knowledge it is hardly profitable to speculate on the nature of this characteristic.

French-Mitcham Peppermint Oil

THE cultivation of the true Mitcham peppermint in France is, according to Dr. J. Ripert, writing in the official agricultural bulletin for May 1, 1926, an exceedingly profitable undertaking. The increased demand for this essential oil in France, due very largely to the reduction in the quantity exported by America, leads Dr. Ripert to the conclusion that the French grower need not anticipate a lack of outlet for his crop. The cultivation practised in France is on similar lines to that of English growers, save that more attention has been devoted to the study of the action of fertilisers, and with remarkable results. Bearing on this question the following table, quoted from Dr. Ripert's report, will be of interest to English growers.

YIELD OF CROP AND OIL

Manure	Weight of green herb in kilos	Oil yield per cent.
Stable manure plus potash, sulphate of ammonia and superphosphate	8,300	2·6
Stable manure, potash, sulphate of ammonia, and chalk	7,900	2·7
Stable manure only	6,000	2·5
Stable manure, potash, superphosphate ..	5,500	2·5
Stable manure, chalk, superphosphate, sulphate of ammonia	7,500	2·9

It is clear, therefore, that this crop responds to applications of fertilisers, a fact not generally recognised by English growers. Further, it has been found that a dressing of nitrate of soda towards the end of May speeds up the opening of the leaf. Some interesting figures are given concerning a cultivation at Sulpice-sur-Leze. The total cost of cultivation is given as 856 francs per hectare (roughly 2½ acres), and the returns, on a yield of 11,000 kilos of herb per hectare, as 4,400 francs, showing a net profit of 3,544 francs per hectare. Variations in the yield of oil, so familiar to English growers, are frequently met with in France. Also, not all the oil produced in French centres possesses the true Mitcham aroma, a quality which makes the English product the finest in the world. On the

whole Dr. Ripert's report is a valuable contribution to the knowledge of this essential oil crop. English growers would do well to experiment with fertilisers on the lines indicated above. It has been known for some time that yields of oil show a higher average in France than in this country, where a yield of 2·5 per cent. would be regarded as maximum. In France, yields as high as 5·5 per cent. have been recorded.

* * * * * *

The Agricultural Index Number

SEVERAL descriptions of agricultural produce were dearer in August than in the previous month, but as the advances were practically neutralised by other commodities becoming cheaper, the general level of the prices of agricultural produce was only 1 point higher than in July, being 49 per cent. above August, 1911-13. In August, 1925, the index figure was 54 per cent. above pre-war, or 5 points higher than for the month under review.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921 :—

	Percentage Increase compared with the average of the corresponding month in 1911-13					
Month	1921	1922	1923	1924	1925	1926
January	180	71	67	60	71	58
February	164	75	63	61	69	53
March	146	73	59	57	66	49
April	145	66	54	53	59	52
May	115	69	54	57	57	50
June	105	64	49	56	53	48
July	103	67	50	53	49	48
August	122	68	52	57	54	49
September	113	59	52	61	55	—
October	82	61	50	66	53	—
November	74	63	51	66	54	—
December	71	61	55	65	54	—

Live Stock

Fat cattle continued to decline in value and were 1s. 6d. per live cwt. cheaper than in July, but as this reduction was relatively less than in the base years, the index number rose 3 points to 43 per cent. higher than in August, 1911-13. A reduction of ½d. per lb. on the month was recorded for fat sheep, and the index number in consequence fell from 59 to 52 per cent. above pre-war level. Fat pigs, on the other hand, were 2d. to 3d. per 14 lb. stone dearer, but as the increase was proportionately less than that shown in the basic period the index number for baconers records a drop of 4 points and that of

porkers 1 point, as compared with the July indices. Both fat cattle and sheep realised lower prices than in August, 1925, the former being 3s. 9d. per live cwt. and the latter 1$\frac{3}{4}$d. per lb. cheaper, but fat pigs were about 2s. per 14 lb. stone dearer than a year ago. Fat pigs averaged about 81 per cent. above pre-war price and were still relatively the dearest of any class of agricultural produce. Average prices of dairy cattle were 3s. per head higher than in July, but the index number was 1 point lower at 37 per cent. above pre-war. Store sheep averaged 6s. 8d. per head less than in the previous month, and the index number fell sharply from 82 to 63 per cent. above the base years. Demand for store pigs was maintained, and with no alteration in price the index figure was unchanged at 139 per cent. above pre-war. Dairy cows and store cattle were both cheaper than in August, 1925, while store sheep sold at much lower prices, but store pigs were considerably dearer, the latter making about 18s. 6d. per head more than a year ago.

Grain

Wheat declined sharply in price during the latter part of August, owing to some new crop being on offer, and averaged 6d. per cwt. less than in July, the index number dropping from 73 to 69 per cent. above pre-war. Oats were 10d. per cwt. cheaper on the month, but as this reduction was relatively the same as that in the base years the index figure was unchanged at an increase of 33 per cent. above 1911-13. Some malting samples of this season's barley were marketed during August, and this caused the average price of barley to advance sharply, as previously only feeding barley of the 1925 crop was on offer. The average increased by 2s. 9d. per cwt. on the month, and as prices were practically unchanged as between July and August in 1911-13, the index number rose 35 points to 52 per cent. above pre-war. As compared with August, 1925, wheat was 1s. 9d. per cwt. dearer, but both barley and oats realised less money, the former being 9d. and the latter 8d. per cwt. cheaper.

Dairy and Poultry Produce

Milk was again 60 per cent. dearer than in August, 1911-13, the contract price for supplies delivered to certain large towns being unaltered at 1s. per gallon. The rise in the price of butter was continued, but as the increase of 1$\frac{1}{4}$d. per lb. was in exact proportion to that of the base years, the index number was unchanged at 56 per cent. above pre-war. Cheese was over £1 per cwt. cheaper on the month, and the index figure declined 35 points. Butter was 2$\frac{1}{4}$d. per lb. and cheese £1 4s. per cwt.

cheaper than in August, 1925. The seasonal advance in egg prices continued, and, as this increase which amounted to 4d. per dozen was relatively much greater than in pre-war years, the index figure rose sharply from 33 to 49 per cent. above the basic period, but even so, eggs were still 2d. per dozen cheaper than a year earlier.

Other Commodities

Potatoes have been in ample supply, and with a slow trade prices have declined throughout August, the average rate being £2 5s. per ton less than in July, and as this reduction was relatively greater than in 1911-13 the index figure shows a drop of 10 points. The increase over pre-war was 11 per cent. as compared with 67 per cent. in August, 1925. Hay prices were steady and were 11 per cent. higher than in 1911-13.

Both cabbages and cauliflowers were considerably cheaper than in July, the former making 27 and the latter 11 per cent. more than in the base years. Apples realised 84 per cent. above pre-war price, but plums, of which there is a good crop, were comparatively cheap at 24 per cent. above. As previously mentioned, vegetables and fruit are no longer taken into account in the calculation of the monthly general index number.

Index numbers of different commodities during recent months and in August, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	Aug.	Aug.	May	June	July	Aug.
Wheat	59	47	67	71	73	69
Barley	75	62	22	21	17	52
Oats	38	43	30	31	33	33
Fat cattle	56	54	43	40	40	43
Fat sheep	100	76	67	66	59	52
Bacon pigs	33	52	88	87	83	79
Pork pigs	35	56	90	90	84	83
Dairy cows	57	50	36	38	38	37
Store cattle	48	39	29	28	33	33
Store sheep	129	91	55	71	82	63
Store pigs	29	57	122	134	139	139
Eggs	63	67	38	26	33	49
Poultry	66	58	61	70	52	55
Milk	58	62	60	60	60	60
Butter	67	73	52	54	56	56
Cheese	66	78	83	80	78	43
Potatoes	72	67	15	−5*	21	11
Hay	3	3	9	9	8	11

* Decrease.

Lectures on the Rothamsted Experiments

DURING the forthcoming winter it will be possible for Mr. H. V. Garner, M.A., the Guide Demonstrator of the Rothamsted Experimental Station, and other members of the staff, to give a few lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted Experiments. Titles of lectures and the names of the lecturers are given under. Only one subject can be dealt with in a single lecture. Any such associations wishing to avail themselves of the services of the lecturers named should communicate with the Secretary, Rothamsted Experimental Station, Harpenden, Herts, indicating which subject or subjects would be of most interest to their members, and the most suitable dates for the lecture. Every endeavour will be made to meet the convenience of associations in the matter of dates, but as much notice as possible beforehand is requested. No fee will be charged for a lecturer's services, but associations will be expected to defray the travelling and hotel expenses of any lecturer engaged by them ; also to make any arrangements for the lecture that may be necessary.

LECTURES BY MR. H. V. GARNER, M.A., B.SC., GUIDE DEMONSTRATOR AND LECTURER

For Farmers

(1) Artificial Fertilisers and Their Use in Practice.
(2) The Management of Farmyard Manure.
(3) The Use of Lime in Agriculture.
(4) Recent Work on the Manuring of Potatoes.
(5) The Use of Fertilisers on Sugar Beet.
(6) Some Points in Manuring a Rotation of Crops.
(7) Manuring as a Factor in Grass Land Improvement.

For Students' Societies and other Bodies

(8) The Rothamsted Field Experiments, 1843-1926.
(9) Recent Additions to the List of Artificial Manures.
(10) The Raw Materials of the Fertiliser Industry.

LECTURES BY MR. C. HEIGHAM, M.A., FARM DIRECTOR

(1) The Growing of Sugar Beet.
(2) The Growing of Lucerne.
(3) Fallow and Fodder Crops.
(4) Malting Barley.
(5) The Common Cereal Crops.
(6) Arable Cultivation—the Use and Development of the Hoe.
(7) The Cultivation and Feeding of Grass Land: (*a*) for Hay, (*b*) for Grazing.
(8) The Balance of the Farm.

OTHER LECTURES AND LECTURERS

Soil Micro-Organisms (Bacteria, Protozoa, etc.)

(1) Lucerne Inoculation.	Mr. H. G. Thornton, B.A.
(2) Life in the Soil.	Mr. D. W. Cutler, M.A.
(3) Biological Aspects of Partial Sterilisation.	Mr. D. W. Cutler, M.A.

Agricultural Botany

Weeds of Arable and Grass Land.	Dr. Winifred E. Brenchley, F.L.S.

Agricultural Chemistry

(1) Green Manuring ; Its Place in British Agriculture.	Mr. H. J. Page, B.Sc.
(2) The Principles of Manuring.	
(3) The Chemistry of Crop Production.	
(4) Humus : Its Value in the Soil and How to Keep Up Its Supply.	Mr. H. J. Page, B.Sc. Mr. R. G. Warren, B.Sc. Mr. H. J. G. Hines, B.Sc.
(5) Basic Slag and Mineral Phosphates : Their Value in Agriculture.	

Soil Physics

(1) The Principles of Soil Cultivation.	Dr. B. A. Keen, F.Inst,P.
(2) Soil Moisture and Temperature, and Their Control.	Dr. W. B. Haines, F.Inst.P. Dr. E. M. Crowther, A.Inst.P.
(3) Liming and Chalking of Soils.	

Insecticides and Fungicides

(1) Control of Wart Disease of Potatoes.	Mr. W. A. Roach, B.Sc.
(2) Insecticides and Fungicides	Mr. F. Tattersfield, B.Sc. Mr. C. T. Gimingham, F.I.C.

Entomology

(1) Insect Pests.	Dr. A. D. Imms, M.A.
(2) Horticultural, Market Garden. and Orchard Pests.	Dr. J. Davidson, F.L.S.
(3) Bee Keeping.	Mr. D. M. T. Morland, M.A.

Mycology

(1) Potato Diseases (Wart, Virus, etc.)	
(2) Plant Diseases : Their Causes and Control.	Dr. W. B. Brierley, F.L.S.
(3) Soil Fungi and Plant Growth.	
(4) Fungus Pests of Crops.	

United Dairies Scholarships.—The second annual award of scholarships from the United Dairies Scholarship Fund has just been announced. The scholarships are open to the sons and daughters of farmers and small-holders in Somerset, Cornwall, Devon, and Dorset, and are tenable at Reading University, the Somerset Farm Institute, Cannington, Bridgwater, and the Seale Hayne Agricultural College, Newton Abbot, Devon.

The successful candidates for this year are as follows :—

Two years' course at Reading University : W. J. Brimacombe, T. A. Green, G. G. Gregory, Miss G. E. Roberts, J. Tucker, and Miss E. Waters.

Two years' course at Seale Hayne Agricultural College : J. H. Cock.

One year's course at the Somerset Farm Institute, Cannington : L. E. G. H. Elliott, Miss M. Knott, and Miss I. A. Ware.

The Fund, amounting to £30,000, which was created in 1924 by United Dairies, Ltd., for the purpose of promoting and encouraging

practical and scientific education in dairying and dairy farming, also provides for one or more Travelling and Research Scholarships to enable advanced students to study these subjects at home or abroad.

The terms and conditions of both ordinary and research scholarships for next year will be issued in the spring.

Foot-and-Mouth Disease.—Since the issue of the September JOURNAL there have been four fresh centres of disease, two of which have necessitated the imposition of restrictions to areas lying beyond the radius of 15 miles from the original disease centres.

In respect of the two areas subject to restrictions when last month's note was published further outbreaks occurred in Somerset on August 20, 25, 26, and 28, since when there has been no development. In the Lanark area, disease occurred at Carstairs on August 31, after an interval of 14 days, and subsequent cases have been confirmed at Kirkmuirhill on September 8 and 15.

On August 29 disease was found to exist on eight separate premises in the vicinity of Colwyn Bay, Denbighshire, and 16 further outbreaks have subsequently occurred, all in the same infected area.

The most disturbing outbreak was that at Battlefield, Shrewsbury, on September 9. Stock from the premises had been exposed in Shrewsbury Market on September 7, and on September 10, disease was found to exist in the abattoir at Liverpool, in one of the fat pigs sold from the infected premises.

There was therefore a grave possibility of the spread of infection through Shrewsbury Market. From the information available it appeared that animals had been moved from that market into the counties of Salop, Stafford, Montgomery, Denbigh, Flint, Cheshire, Lancashire, and Warwickshire. It was not certain at that time whether any animals had been sent to Herefordshire, Worcestershire, or Radnorshire, but as several private sales of animals sold at Shrewsbury Market had since taken place it was decided by the Ministry to apply Infected Area Restrictions to all the counties above-mentioned, including Hereford, Worcester and Radnor for the time being, until further information became available that any of these counties were not involved, or until the expiration of a period of 14 days had lapsed from the date of Shrewsbury Market. An Order was accordingly made on the 10th instant.

When it was definitely ascertained that no animals from Shrewsbury Market of September 7 went into Herefordshire or Radnorshire, or into the southern parts of Warwickshire and Worcestershire, an Order was made on September 14 releasing Hereford, Radnor, and the southern parts of Warwickshire and Worcestershire.

No further outbreak having occurred in the Midlands area, the restrictions were removed as from September 22.

The other outbreak involving special action was that at Stanford, Hythe, on the 15th instant, in which case Ashford Market was involved. A subsequent outbreak at Benenden on the following day was definitely connected with the initial case, and, in view of the distribution of stock from that market, restrictions were imposed on the remainder of Kent and on parts of East Sussex on September 16.

These outbreaks bring the total for the year to 171, involving 24 counties and the slaughter of 4,793 cattle, 10,799 sheep, 1,880 pigs, and seven goats.

Enforcement of Minimum Rates of Wages.—During the month ending September 15, legal proceedings were instituted against ten employers for failure to pay the minimum and overtime rate of wages fixed by the Orders of the Agricultural Wages Board, for workers in agriculture. Particulars of the cases are as follows :—

County	Court	Fines	Costs	Arrears of wages ordered to be paid	No. of workers concerned
		£ s. d.	£ s. d.	£ s. d.	
Somerset ..	Glastonbury ..	—	0 4 0	9 17 5	1
,, ..	,, ..	3 0 0	6 15 0	11 14 0	6
,, ..	,, ..	—	0 4 0	14 19 6	1
,, ..	Shepton Mallet	0 10 0	0 5 0	9 11 9	1
,, ..	,,	2 0 0	1 0 0	14 1 0	4
Suffolk ..	Saxmundham ..	—	0 5 0	5 0 0	1
Hereford ..	Leominster ..	2 2 0	0 2 6	20 18 0	1
Dorset ..	Cerne Abbas ..	0 8 0	0 3 0	1 16 8	2
Hereford ..	Hereford City ..	12 0 0	0 7 6	45 5 4	7
Glamorgan	Bridgend ..	1 0 0	—	16 10 0	1

In regard to the proceedings at Saxmundham summonses were issued in respect of four workers. In one case the charge was dismissed under the Probation of Offenders Act and the arrears of wages as indicated were ordered to be paid. In another case the summons was dismissed and an appeal is pending, and as the remaining cases involved a similar point they were adjourned, *sine die*.

Proceedings were also instituted against an employer at Axminster (Devon) under Section 9 (3a) (hindering an officer in the exercise of his duties) and Section 9 (3b) (refusal to give information) of the Agricultural Wages (Regulation) Act, 1924. The defendant was fined £3 in respect of each charge.

Leaflets Issued by the Ministry.—Since the date of the list given in the April issue of the JOURNAL, p. 91, the following leaflets have been issued :—

Rewritten :—

No. 59. Improvement of Land Acts (England and Wales).
No. 77. Finger-and-Toe Disease.
No. 252. Pruning of Stone Fruit Trees.
No. 328. The Smuts of Barley and of Oats.

Revised :—

No. 95. Ringworm in Cattle.
No. 131. Apple and Pear Scab.
No. 146. The Value of Records of the Milk Yield of Cows.
No. 229. The Breeding and Rearing of Turkeys.
No. 233. Actinomycosis or Hard Tongue in Cattle.
No. 276. Commercial Mushroom Cultivation.
No. 388. The Feeding of Dairy Cows.

Amended :—

No. 7. The Wheat Bulb Fly.
No. 29. Swine Fever.
No. 101. Prevention of White Scour in Calves.

NOTICES OF BOOKS

Rothamsted Conferences. (London: Ernest Benn, Ltd. Price 1s. 6d. each net.)

During the last 12 months, conferences on present-day problems in crop production, which are of interest to farmers no less than to agricultural advisory and research workers, have been held at the Rothamsted Experimental Station, and others will be arranged from time to time. Papers dealing with various aspects of the subject under discussion are read by well-known experts and are followed by a general discussion. Summaries of the proceedings have appeared after each conference in the Ministry's JOURNAL, and it is now possible to obtain in pamphlet form full reports of some of the more recent conferences, those which have already appeared being: I, "The Growing of Lucerne," and II, "The Culture and Manuring of Fodder Crops."

The Social and Economic History of the Roman Empire. By M. Rostovtzeff. (Oxford: at the Clarendon Press, 1926. Royal 8vo., pp. xxvi + 696, with sixty illustrations in half-tone. Price 45s. net.)

A Roman history is not a book which would ordinarily be noticed here. But any work dealing with social and economic history should have some interest for the student of agricultural development. From a social and economic point of view such a reader will find much to interest him in Prof. Rostovtzeff's pages. The technical side of agriculture, though not falling directly within the scope of the book, is well represented in the plates with which the book is illustrated. More than a third of the figures shown in the first forty-eight plates are concerned with agricultural subjects. The value of the work is immensely enhanced by the wealth of references contained in the notes, which constitute considerably more than a quarter of the book. The reader who wishes to follow up any line of inquiry, whether suggested by text or plates, will find in these notes all manner of help and direction. The book is a model of exhaustive and judicious documentation.

It may be mentioned that the earlier periods of Roman history have been presented from the same aspects in Prof. Tenney Frank's stimulating *Economic History of Rome to the End of the Republic* (Baltimore: Johns Hopkins Press, 1920), while for Greece Prof. Glotz's *Le Travail dans la Grèce ancienne* (Paris: 1920; translated under the title of *Ancient Greece at Work*. London: Kegan Paul, 1926) may be consulted.

Rothamsted Experimental Station Library. Catalogues of the Printed Books on Agriculture published between 1471 and 1840, with Notes on the Authors by Mary S. Aslin.

This catalogue of some 1,500 books is arranged according to two systems: an author catalogue in alphabetical order, and a chronological list subdivided according to countries. It will prove very useful not only to those using the Rothamsted Library, but to many interested in the history of agriculture. The English historical section (which includes translations into English) contains various errors which ought to be corrected if a reprint be required, the historical facts being of importance. For example, Strabo lived well into the Christian era, and his work on geography was not written, as suggested, *c.* 63 B.C.; if it had been, he could not have had knowledge of Cæsar's expeditions to Britain. Birch's *Cartularium Saxonicum* does not give "general descriptions of the districts to which the charters relate";

and *Piers Plowman* was not "finished in 1369." Such errors may not matter greatly to the agricultural historian, who is not likely to read Strabo or *Piers Plowman* for the information they give; nor, if he possesses the equipment to deal with Saxon charters, will he in any way be misled by the note on the *Cartularium Saxonicum*. Further, the author is sometimes at fault when dealing with more modern books. The dates given for the career and publications of Charles Varley or Varlo are widely inconsistent: for a man whose career is conjecturally placed between the years 1752 and 1795 could hardly return to England in 1760 after a farming career in Ireland and publish the third edition of one of his books in 1722! Obviously there has been at least very indifferent proof-reading in a technical publication where accuracy is the first essential. Again, an anonymous *Treatise of Wool and Cattel* (1677) is attributed to Roger L'Estrange, whereas the title page shows clearly that he was the licenser of the print.

The lack of accuracy does not inspire confidence, but on general grounds the publication is very welcome: it is well produced, there are a number of interesting reproductions, and it is bound to be extensively consulted because of the great amount of valuable reference work Miss Aslin has accomplished.

Guide to Current Official Statistics, Volume 4, 1925. (H.M. Stationery Office. Price 1s. net.)

The fourth volume of the *Guide to Current Official Statistics*, prepared by the Permanent Consultative Committee on Official Statistics, continues the series of annual surveys of the statistics contained in Government publications, and deals with all those issued in 1925 and with a selection of those issued in 1926. It may be remarked that the second volume of this series included an appendix covering the more important publications issued since 1900. The aim of the *Guide* is not only to place the inquirer in touch with the volumes bearing generally on his subject (usually the sole function of the ordinary type of subject index), but more particularly to inform him which, if any, of these volumes contain statistical information analysed in the manner he desires. These objects are secured by a systematically-planned subject index, from which references are made by means of serial numbers to the various volumes included in a list of publications. The introduction to the *Guide* explains, with suitable examples, the method of using it, whilst the novel system of cross-references, described in paragraph 5, insures that the whole of the published material on any given subject can be traced with certainty, often a matter of considerable difficulty with the usual form of index. Thus, for example, a student of coalmining can in a few minutes be made aware of all the officially published statistics bearing on the industry.

Cambridge University Agricultural Society's Magazine, 1926. (Obtainable from the Editor, School of Agriculture, Cambridge. Price 2s. 9d. post free.)

Among a number of interesting articles in this "Annual," that on "An Acre of Corn," by Mr. F. L. Engledow, will attract attention for its breezy description of an experiment in estimating the yield of a field of wheat. "The Food Supply during the War" summarises a paper which Sir Thomas Middleton read to the Society last November, and shows how the Government's agricultural policy had to be varied to meet sudden emergencies arising in consequence of submarine warfare and money shortage, "with results that led many farmers to declare that the Government did not know what it *did* want." Dr. F.

H. A. Marshall details in "Fecundity in Farm Animals" some interesting deductions from recent investigations in animal breeding. Dr. E. S. Beaven contributes "Some Observations on Barley," in the course of which he asserts that average farm results might be more largely drawn upon for useful information on the productivity of different races of plants; Mr. Arthur Amos writes about "The University Farm," and Mr. W. R. Peel upon "Arable Dairy Farming." As a digression from these serious questions, the magazine exhibits a strongly humorous side, of which a mock interview with Professor Sir Bouldleigh Bluffin, on the merits of his Yeoman XXXIII, is an excellent example. This *nom-de-plume* will hardly conceal from readers of this JOURNAL the identity of the distinguished personality at Cambridge who generously countenances this witticism, even if it were not revealed in the accompanying photograph of the "Professor" holding a colossal ear of the supposed new wheat, the grains of which are so large that when baked, after steeping and the insertion of yeast, they form loaves in themselves!

A Practical Handbook on Rat Destruction. By C. Leopold Claremont, B.Sc., F.I.C. (London: John Hart, 180 pp., price 3s. 6d.)

This is essentially a book for officers under the Rats and Mice (Destruction) Act, 1919, and gives in succinct style all that is requisite to administer the afore-mentioned Act. The author has had many years' practical experience in exterminating rats and mice, and the book is a work of a practical nature. Its handy size permits of its being easily carried in the pocket; thus it can be consulted while actually carrying out the duties of a rat officer.

ADDITIONS TO LIBRARY

Field Crops

The Culture and Manuring of Fodder Crops.—Being the report of a conference held at Rothamsted on March 30, 1926, under the chairmanship of the *Right Hon. Lord Bledisloe, K.B.E.* With contributions by *Sir John Russell, W. A. C. Carr, J. C. Brown, C. Heigham, etc., etc.* (40 pp.) London: Ernest Benn, Ltd., 1926. 1s. 6d. [63.33; 63.33-16; 63.332.]

Washington Agricultural Experiment Station.—Bulletin No. 198:—Rotation and Hogging Off Experiments with Field Peas. (21 pp.). Pullman, 1926. [63.32; 63.64.043.]

Horticulture and Fruit

Galt, A. S.—The Principles and Practice of Horticulture. (240 pp.) London: University Tutorial Press, 1926. 3s. 6d. [63.51; 63.41.]

Dallimore, W.—The Pruning of Trees and Shrubs. Being a description of the Methods Practised in the Royal Botanic Gardens, Kew. (92 pp. + 8 pl.) London: Dulau, 1926, 4s. 6d. [63.524-195.]

U.S. Department of Agriculture.—Farmers' Bulletin No. 1471:—Canning Fruits and Vegetables at Home. (22 pp.) Washington, 1926. [664.84; 664.85.]

Pennsylvania Agricultural Experiment Station.—Bulletin No. 191:—Construction and Management of the Bank Storage Cellar (for Fruit and Vegetables.) Supplement to Bulletin No. 191:—Plans and Specifications of Above-ground Air-cooled Apple Storage House. (32 pp.) Centre County, 1925. [69; 63.41-198; 63.51-198.]

Imperial Economic Committee.—Report on the Marketing and Preparing for Market of Foodstuffs Produced in the Overseas Parts of the Empire. Third Report:—Fruit. [Cmd. 2658.] (274 pp.) London: H.M. Stationery Office, 1926, 4s. 6d. [63.41:38.]

California Agricultural Experiment Station.—Bulletin No. 398 :—Orchard Heating in California. (69 pp.) Berkeley, 1925. [63.21 ; 63.42.]

Plant Pests and Diseases

Wye South-Eastern Agricultural College (Advisory and Research Dept.)—Bulletin No. 4 :—The American Grey Squirrel (*Neosciurus carolinensis* Gmelin) in Kent, Sussex, and Surrey. By *F. V. Theobald.* (16 pp. + 3 maps.) Wye, 1926. 1s. [63.269.]

Theobald, F. V.—The Plant Lice or Aphidæ of Great Britain. Vol. I (372 pp.) Ashford and London : Headley Bros., 1926. [63.27; 59.57.]

U.S. Department of Agriculture.—Farmers' Bulletin No. 1461 :—The Common Cabbage Worm (*Pieris rapæ L.*) and Its Control. (14 pp.) Washington, 1926. [63.27.]

Washington Agricultural Experiment Station.—Bulletin No. 199 :—Poisoned Baits for Strawberry Root Weevils (*Brachyrhinus sulcatus* and *B. ovatus*). (22 pp.) Pullman, 1926. [63.27.]

Cunningham, G. H.—Fungus Diseases of Fruit-Trees in New Zealand and Their Remedial Treatment. (414 pp.) Auckland, N.Z. : New Zealand Fruitgrowers' Federation & Brett Publishing Co., 1925. [63.24-41].

Pennsylvania Agricultural Experiment Station.—Bulletin No. 190 :—Comparison of Materials Used in Spraying and Dusting for Apple Scab (*Venturia inæqualis*) Control in Pennsylvania. (20 pp.) Centre County, 1925. [63.24.]

U.S. Department of Agriculture.—Farmers' Bulletin No. 1479 :—Apple Blotch (*Phyllosticta solitaria*). (11 pp.) Washington, 1926. [63.24.]

U.S. Department of Agriculture.—Dept. Bulletin No. 1364 :—Effects on Honey Bees of Spraying Fruit Trees with Arsenicals. (32 pp.), Washington, 1926. [63.295 ; 63.81.09.]

Dairy Farming

Yapp, W. W., and *Nevens, W. B.*—Dairy Cattle : Selection, Feeding, and Management. (395 pp.) New York : J. Wiley ; London : Chapman & Hall, 1926. 11s. [63.711.]

Glasgow, West of Scotland Agricultural College.—Bulletin No. 106 :—Feeding the Dairy Cow. By *A. C. M'Candlish.* (100 pp.) Glasgow, 1926. [63.711.]

Boutflour, R.—Management and Rationing of Dairy Cows. (16 pp.) [Reprint from Journal British Dairy Farmers' Association, Vol. 37 (1925).] London : British Dairy Farmers' Association, 1925. 6d. [63.711.]

Wye, South-Eastern Agricultural College.—Dept. of Economics :—Investigation into Farming Costs of Production and Financial Results Report No. 1 :—Milk Production Costs and Financial Results, 1923-24 and 1924-25. By *James Wyllie.* (35 pp.) Wye, 1926. 1s. [63.714.]

Veterinary Science

Glasgow, West of Scotland Agricultural College.—Bulletin No. 107 :—Contagious Mammitis in Cows. By *A. C. M'Candlish.* (18 pp.) Glasgow, 1926. [619.2]

Leeds University and the Yorkshire Council for Agricultural Education.—Bulletin No. 146 :—Eradication of Tuberculosis from a Herd of Cattle. A description of the measures adopted at the Manor Farm, Garforth, for the eradication of tuberculosis from the herd. By *H. G. Bowes.* (16 pp.) Leeds, 1926. [619.2 ; 63.711.]

Keevil, J. J.—Case for World War on Foot-and-Mouth Disease. (24 pp.) London : Simpkin, Marshall, Hamilton, Kent & Co., 1926. 1s. [619.2.]

U.S. Department of Agriculture.—Dept. Bulletin No. 1369 :—The Cattle Grubs or Ox Warbles : Their Biologies and Suggestions for Control. (120 pp.) Washington, 1926. [619.2.]

New Jersey Agricultural Experiment Station. Bulletin No. 425 :—Bacillary White Diarrhœa Control in New Jersey, 1924-25. (22 pp.) New Brunswick, 1926. [619.5.]

Poultry

Toovey, T. W.—Commercial Poultry Farming. A Description of the Evolutionary Progress of the King's Langley Poultry Farm and its Management. 4th Edn. (151 pp. + 15 pl.) London: Crosby Lockwood, 1926. 6s.' [63.65.]

Department of Scientific and Industrial Research.—The Storage of Eggs. By *T. Moran* and *J. Piqué* [Food Investigation Board Special Report No. 26.] (88 pp.+9 pl.) London: H.M. Stationery Office, 1926. 1s. 3d. [63.742.]

U.S. Department of Agriculture.—Dept. Bulletin No. 1385:—The Poultry and Egg Industry in Europe. (61 pp.) Washington, 1926. [63.65 (4).]

Cork University.—Agricultural Bulletin No. 2:—A Statistical Analysis of Irish Egg Production, Prices, and Trade. By *J. Busteed.* (62 pp.) Cork: University Press; London: Longmans Green, 1926. 1s. [63.65 (415).]

Union of South Africa Egg Export Commission.—Report of Egg Export Commission of Investigation. (48 pp. foolscap.) Cape Town: Government Printers, 1926. [63.741.]

New Mexico Agricultural Experiment Station.—Bulletin No. 147:—Artificial Incubation of Hen Eggs in New Mexico (24 pp.) State College, 1925. [63.651-041.]

New Mexico Agricultural Experiment Station.—Bulletin No. 150:—The Relative Feeding Value and Cost of Milk (Semi-solid Buttermilk) in Egg Production. (32 pp.) State College, 1925. [63.651-043.]

Washington Agricultural Experiment Station.—Popular Bulletin No. 134:—Methods of Dimming Lights for Poultry Houses (31 pp.) Pullman, 1926. [63.65 : 69 ; 537.]

Agricultural Engineering

Oxford University Institute of Agricultural Engineering.—Bulletin No. 1:—A Report on the Use of Windmills for the Generation of Electricity. (63 pp. + 6 pl.) Oxford: Clarendon Press, 1926. 2s. 6d. [63.17 ; 537.]

Cronshaw, H. B.—Modern Drying Machinery. (159 pp.) London: Ernest Benn, 1926. 6s. [63.17.]

Economics

University College of Wales, Aberystwyth, Agricultural Economics Department.—Bulletin No. 3:—Welsh Studies in Agricultural Economics. By *A. W. Ashby* and *J. Morgan Jones.*

I. Human Motives in Farming.
II. The Social Origin of Welsh Farmers.
III. The Place of Cereal Growing in Welsh Agriculture.
IV. Capital and Equipment on Welsh Farms.

(56 pp.) 1926. 1s. [338.1 (429).]

U.S. Federal Trade Commission.—Report on Co-operation in Foreign Countries. (202 pp.) Washington, 1925. [334 (4) ; 332.71 (4).]

Ministry of Agriculture and Fisheries.—Report on the Marketing of Potatoes in England and Wales. [Economic Series No. 9.] (107 pp. + 6 charts + 9 pl.) London: H.M. Stationery Office, 1926. 1s. 6d. [63.512 : 38.]

International Institute of Agriculture, Rome.—The Cotton Growing Countries, Present and Potential. Production, Trade, Consumption (xxxvi + 317 pp.) London: P. S. King, 1926. 12s. 6d. [63.34113 ; 38.]

Jones, D. T., Duncan, J. F., Conacher, H. M., and *Scott, W. R.*—Rural Scotland During the War. [Carnegie Endowment for International Peace. Economic and Social History of the World War, British Series.] (327 pp.) London: Oxford University Press, 1926. 12s 6d. [63 (08) ; 331 (41) ; 325 (41).]

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NOTES FOR THE MONTH

Improvement of Methods of Marketing Agricultural Produce

THE Empire Marketing Board, on the recommendation of the Imperial Economic Committee, has sanctioned a grant to the Ministry of Agriculture for the purpose of carrying out further investigations into the methods of marketing home-grown agricultural produce and for educating home producers as to the possibilities of improvement. It will be remembered that the Empire Marketing Board is charged with the duty of administering the annual grant of £1,000,000 sanctioned by Parliament for the furtherance of the sale of Empire products (including home agricultural produce), and the grant which has now been made to the Ministry is the result of representations by the Minister as to the participation of home agriculture in the Empire Marketing Grant. The Ministry's grant, which amounts to a sum not exceeding £40,000 per annum for five years, is intended to be specially devoted to the problem of improved marketing of British produce. The position is summed up in the following extract from the Memorandum submitted by the Minister to the Imperial Economic Committee :—

> " There is a very urgent need for improving marketing methods in England and Wales, but there is no agreement among producers how this should be done. Obviously, if there were any simple solution which could be relied upon to give commercial results suited to the special conditions of this country, it would have been found long ago. The conditions affecting the different commodities are, moreover, entirely different. In short, the problem taken as a whole is one of the greatest complexity. The first need, therefore, is full investigation of the conditions under which the different commodities are sold with a view to suggesting means by which improvements can be secured. The second stage is to secure such agreement among producers on these proposals as will induce them to adopt

them in practice. Thus the task on the one hand is economic or commercial research, and, on the other, publicity, propaganda, demonstration and experiment."

The Imperial Economic Committee, in making their recommendation to the Empire Marketing Board, made the following observations :—

"In our First Report we have unanimously and emphatically expressed the opinion that the home producer should enjoy the first place in the home market, and that any assistance which might be granted to the overseas Empire producer should be designed to give him a preference over his foreign competitor, but not at the expense of the home agriculturist. We have consistently regarded the interests of the home and overseas agriculturists as complementary, but there are certain difficulties in the way of an immediate advertising campaign aimed at assisting the home producer. With some notable exceptions, home agricultural produce is still inferior in regard to grading, packing, and presentation to similar imported produce. For an advertising campaign to be successful the highest standards of grading and packing are essential.

"We are finding in our investigations into the marketing of overseas dairy produce that the present unorganized marketing of the home output is an impediment to a publicity campaign on behalf of the whole Empire such as we should like to see inaugurated. We recognize that the relation of the home producer to the home market is such as does not lend itself very easily to organized marketing, and we, therefore, welcome the Minister's scheme, on one hand for investigation into the practicability of new methods of marketing, and on the other hand for propaganda with a view to the adoption of such methods. We also recognize that the benefits accruing from the expenditure proposed by the Minister will not enure solely to the home producer. The producer in the overseas parts of the Empire cannot fail to derive assistance in his marketing policy from further expert investigation of market conditions in the United Kingdom, no matter in whose primary interest such investigation may be undertaken.

"We think that the action proposed should be conducted in such a form that the home farmer may appreciate that he is partaking in an Empire effort."

As suggested above, the problem of assisting home producers in the marketing of their produce is a very complicated one, and development must necessarily be slow. It will be possible in due course to make use of the grant for many purposes and in many directions, but for the moment the Ministry regards the exhaustive investigation of marketing methods as the first and primary step.

Investigations of this type have been in progress for some time past and a number of reports have already been issued by the Ministry in the series known as the "Economic Reports."* Two reports have been issued during the past month and are reviewed in this issue of the JOURNAL. These deal with poultry and pigs. Other commodities dealt with earlier are eggs, wool and potatoes, while reports have also been issued on various aspects of co-operation, and also on agricultural credit. It is hoped that it will be possible to issue very shortly a general survey of markets in England and Wales, while reports on fruit, milk and cereals are in preparation.

Apart from the subjects already in hand, there are a number of others which will be taken up at an early date, and these will include the marketing of cattle and sheep, butter and cheese, pork and bacon, and vegetables. These investigations involve a great amount of inquiry into trade conditions, as they have necessarily to cover the various stages of marketing from the point of production to the point of retail sale. A complete examination of existing practices is thus necessary before reliable reports can be issued, and it will, therefore, be some time before the whole series of agricultural products can be covered.

The aim of these Reports is to give not only a descriptive account of English marketing methods, but, as far as possible, to make constructive suggestions as to directions in which the marketing of home produce can be improved. The suggestions are made on the basis of the facts ascertained in the investigation, but are admittedly subject to further examination and testing in actual practice. They are in the strict sense of the word "suggestions." Many of them relate to such questions as the grading, packing, and general standardization of home produce in a way which will enable it to compete more successfully with imported goods.

The next step following on the investigations is the demonstration of such suggestions as lend themselves to treatment in

* A complete list of those already published and of those in preparation is given on page ix of the advertisements.

this way. For example, at the Show at Birmingham, from November 2 to 4, 1926, which is being held under the auspices of the Birmingham Agricultural Society and the Midland Federation of Fur and Feather Societies, a preliminary demonstration of methods of marketing poultry and eggs will be given. A full description of this demonstration will be given in the next issue of this JOURNAL. It is hoped that it will be possible to give similar demonstrations next year at the principal agricultural shows, and these will probably deal not only with poultry and eggs, but also with other commodities such as pigs, pork and bacon, fruit, wool, etc. These demonstrations, it may be noted, have to cover the whole process from the point of production to the final sale to the consumer. The producer is only one link in the chain, and the effective sale of his produce is dependent not only on his supplying the market with what is required, but also on its proper manipulation and distribution after it has left his hands.

It is hoped by means of these demonstrations and by means of leaflets and other forms of publicity to bring the whole subject of the improved marketing of agricultural produce actively to the notice of the home producer, and to provide means whereby possibilities of improvement can be discussed and considered by those concerned.

The above is merely intended as a preliminary indication of certain lines of work which it is proposed to undertake with the aid of the grant.

Poultry Marketing

AN informative Report* on the marketing of poultry in England and Wales has recently been issued in the Ministry's "Economic Series," containing suggestions for the improved marketing of table poultry that merit the careful consideration of producers and distributors.

In Part I, a "Preliminary Survey," the sources of supply, prices, and the general course of the trade are passed in review. Imports of live and dead poultry, which at present do not exceed 25 per cent. of the total supplies, are traced back to their countries of origin, and their seasonal nature is briefly indicated.

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* *Report on the Marketing of Poultry in England and Wales*, "Economic Series," No. 11, Ministry of Agriculture and Fisheries. Obtainable from H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, or through any bookseller. Price 6d., post free 9d.

The object of Part II of the Report is to describe the processes involved in the preparation of poultry for market and to indicate lines of improvement. The "conditioning" of birds for market is distinguished from the more lengthy and often specialised process of fattening, and in both cases comparison is made with practices abroad. Systematic conditioning for varying periods before slaughter should play an increasingly important part in the future course of the industry. Brief but instructive notes on the subsequent processes of killing, plucking, roping, shaping, cooling, drawing and trussing describe the present procedure adopted in the trade. Careful study of the best methods of processing will do much to remove the anomaly that "foreign poultry of inferior quality often makes as good a price on the English market as superior home produce, solely on account of its better preparation. which includes efficient grading and packing."

The planning of a workable system of grading is described as "the greatest problem before the British poultry industry"; in the light of this assertion, the comprehensive grading systems adopted in the domestic trade of the United States and Canada are examined in the Report; and a suggested scheme of classification and grading by weight and quality for live and dressed poultry, applicable to the home trade, is put forward. The Report states that this scheme has met with the approval of leading distributors, who realize that the present lack of uniform terminology, of a standard system of price quotation, and of well-defined quality distinctions that are accepted and understood generally, leads too frequently to a state of affairs on the wholesale markets that is little short of chaotic. Packaging and grading are correlative. Use of the strong, light, non-returnable types of packages of suitable standard sizes, recommended in the Report, should, therefore, be seriously considered.

In Part III, which treats of assembling, it is urged that the function of country wholesaling, whether done by private traders or producers in co-operation, is a pivotal function in the marketing of home produce, particularly in the surplus-producing areas of England and Wales, and its importance is not realised here to the same extent as in the surplus-producing areas of the Continent and in America. It may be said to include the services of assembly, conditioning and fattening when necessary, killing and dressing, grading, packing and consigning. The greater efficiency and economy of the large unit is readily seen at this stage of the marketing process.

Passing from the subject of transportation in Part IV, where the rail, road and postal systems are considered as alternative methods of dispatch, there follows, Part V, a description of the channels by which poultry is distributed among consumers. The advantages and limitations of direct sale to consumer and of producer-retailer marketing are seen in sharp relief in the poultry trade owing to the perishability of the product, while the uncertainty of consumer demand is said to result in a relatively higher proportion of home-produced poultry than of eggs being disposed of through the medium of the wholesale markets.

Part VI discusses the potentialities of cold storage, especially in regard to supplies of "blackberry" chickens, cold-stored in the autumn for withdrawal in the spring.

In the conclusion (Part VII), where stress is laid on the necessity for education in poultry marketing, the view is expressed that there is no inherent reason why the production of table poultry should not, in course of time, assume a position of far greater importance in the poultry industry of this country than is the case to-day—but, as the Report clearly shows, the way lies through better marketing.

Poultry keepers and all who handle home-produced table poultry should obtain a copy of this Report and read and master the array of facts and suggestions that it contains. With the aid of the grant recently made to the Ministry by the Empire Marketing Board, the Report is being issued at the nominal price of 6d. in order to ensure a wide circulation. Arrangements have also been made for copies of the Report on the *Marketing of Eggs in England and Wales* ("Economic Series," No. 10) to be sold at 6d. net in future. These two Reports represent the most comprehensive review of the marketing of poultry products that has yet been published. No producer can afford to be without them.

Marketing of Pigs

A REPORT of considerable interest to pig breeders and pig feeders is that on the marketing of pigs which has just been issued in the Ministry's "Economic Series"* of publications. Part I of the Report deals with the extent and derivation of supplies of pig products, and shows the growing dependence upon imports. Since 1867, home

* *The Marketing of Pigs in England and Wales*, "Economic Series," No 12. Obtainable from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C. 2, or through any bookseller. Price 6d., post free, 9d.

production has practically stood still, a fact which may partly be accounted for by the growth of the liquid milk market at the expense of other branches of dairying, the decline of pig keeping on small holdings and allotments, and the uncertainty of the returns from pig keeping. The inability of the English pig industry to develop is also bound up with the fact that " home production is, in many ways, out of harmony with demand." Too little attention is given to the requirements of the pork and bacon markets in regard to weight, conformation, carcass quality, and the breeds and crosses favoured. These are accordingly set out in detail in Part II of the Report.

Part III, which treats of assembly and grading, contains an account of the business of pig dealing. The description of the co-operative marketing of live pigs as practised by the Eastern Counties Farmers' Co-operative Association will be of assistance to any similar dispatching societies that may be set up in surplus-producing areas. The practice of grading is examined in the light of the practice in Germany, the United States and Canada.

Transportation is discussed in Part IV, and the customary channels of distribution are reviewed in Part V. The relative importance of the bacon and pork markets in the matter of price is dealt with *inter alia* in Part VI.

In conclusion, a policy is adumbrated and certain suggestions are put forward for consideration. Not only is there the gap created by the recently imposed embargo on fresh pork imports from the Continent, but the more serious problem of replacing the 23½ million pounds' worth of mild-cured, Wiltshire-side bacon of Continental origin by home-produced bacon of equally high uniform quality awaits solution. The suggestions include the establishment of a Pig Industry Committee under the ægis of the Ministry of Agriculture and Fisheries to secure the co-operation of all connected with the industry. The extension of the principle of live pig-marketing societies is also suggested for the better regulation of distribution; these, it is held, would afford the foundations on which might gradually be built a structure of collective bargaining, while they would facilitate any efforts that might be made jointly by producers and curers to stabilise prices over short periods; they would also help to generalize the practice of sale on the basis of recognized grades both of weight and quality. A schedule of weight grades is tentatively advanced as a suggested basis of classification for the purpose of price recording.

In view of the opportunity for expansion which is now open to the pig industry, the Report is commended to the careful attention of all concerned. With the aid of the grant recently made to the Ministry by the Empire Marketing Board, it is being issued at the nominal price of 6d., in order to ensure a wide circulation.

Allotments in 1925

THE Stationery Office has recently published the Report for 1925 which the Ministry is required to make to Parliament under Section 59 of the Small Holdings and Allotments Act, 1908.* The Report reviews the position as revealed by the statistical returns received by the Ministry from Allotments Authorities in England and Wales, and as the returns were more comprehensive than those of previous years, and were received from a greater number of authorities, it has been possible to give a more accurate estimate of the total number and acreage of allotments than has been the case hitherto. Information has also been obtained as to allotments provided by private owners, including railway companies. It is estimated that the number of allotments in England and Wales at the end of 1925 was 1,106,000, covering an area of 163,000 acres, as compared with 1,170,000, covering 168,500 acres at the end of 1924. These figures show a continuance of the decline that has taken place since 1920, but it is pointed out that too much importance should not be attached to this decline, as a considerable decrease was inevitable, having regard to the purely temporary character of great numbers of the allotments created during and immediately after the war. A comparison with the position just before the war reveals an increase of 25,839 acres in the area of allotment land provided by Local Authorities, a particularly satisfactory feature being that the proportion of land owned by the Authorities has increased by over 11,000 acres, that is to say, from one-quarter to one-third of the total. This means that probably more than 100,000 additional allotment holders have been given security of tenure since 1914.

Other paragraphs of the Report deal with the unsatisfied demand for allotments at the end of the year, and with the action of the Ministry in connection with the administration of the Allotments Acts during the year. Appendices to the

* The Report is obtainable (price 6d.) from H.M. Stationery Office, Adastral House, Kingsway, W.C. 2, or through any bookseller.

Report contain detailed statistics compiled from the returns, and particulars of the action taken by the Ministry under Section 8 of the Allotments Act, 1925, in connection with applications received from Allotments Authorities for consent to the disposal, for other purposes, of land purchased by them for use as allotments.

Co-operative Bacon Factories

A LITTLE over a year ago, when several of the co-operative bacon factories in this country were experiencing serious difficulties, the National Farmers' Union, whose initiative in the matter is to be commended, appointed a Committee of Investigation to inquire into the economic position of the co-operative bacon factory industry. The Marquess of Linlithgow presided over the Committee, which included a representative of the Ministry. The Committee's Report* has now been issued.

The Report gives a *résumé* of the history and working of the six factories whose operations were reviewed by the Committee, and proceeds to deal in successive chapters with questions of capitalization, factory administration, equipment and technique, supplies and selling. Of the two appendices, one sets out certain suggested alterations and additions to the N.F.U. model rules for co-operative bacon factory societies, and the other contains a complete set of specimen bacon factory accounts. There is also a concluding chapter to the Report, where, in addition to summarizing the position in general terms, the Committee make a number of important observations on the subject of the future of the pig industry of this country. The Committee remark that pig feeding, taken over a series of years, seems to be as profitable as any other form of stock raising; that the best results have been obtained by those farmers who both breed and fatten the progeny of their herds; that there is need for agreement between farmers and curers as to the type of pig most suitable for conversion into bacon, and that producers should endeavour to supply better-bred and better-fed pigs, their efforts in this direction being aided and supplemented by the establishment of breeding centres and testing stations.

* *Co-operative Bacon Factory Industry.* Report of a Committee of Investigation. Published by the National Farmers' Union, 45 Bedford Square, London, W.C. 1. Price 6d.

The combination of producers for the marketing of live pigs is referred to favourably as a course which might eventually afford a basis for collective bargaining in pig prices, if not for some measure of price stabilisation. The recommendation is also made that the National Farmers' Union should take up with the curers the question of payment for quality. The Committee do not advocate any general extension of curing facilities for the time being, but look forward to the time when the "pig industry of this country, fostered by an enlightened and co-ordinated policy both of production and marketing, will come into its own." A recommendation, the outcome of which will be awaited with interest, is that the National Farmers' Union should convene a meeting of representatives of those of the factories that have suspended curing in order to examine future possibilities.

The difference of opinion among the members of the Committee which is revealed in Chapter V (Supplies), where the question of membership-contracts and the method of payment for pigs is discussed, will be of service to the farming community if it directs attention to these difficult problems of procedure, the importance of which to the stability and permanence of co-operative organizations cannot be over-estimated.

The Preservation of Eggs

To the many persons who are interested in the preservation of eggs, either on a large scale for trading purposes or in small quantities for home consumption, Special Report No. 26, "The Storage of Eggs" (by T. Moran and J. Piqué), issued by the Department of Scientific and Industrial Research, is of value, particularly in view of the attention now being devoted to the methods of marketing British eggs. As Sir W. B. Handy, F.R.S., Director of Food Investigation for the Department, points out in a prefatory note, the report is not confined merely to the result of experiments, but includes a critical survey of existing commercial methods of handling and storing eggs. There is also a section of the report giving information, as the result of actual experiments, on the effect of temperature and storage upon the fertility of eggs, which will appeal to egg farmers. Furthermore, in view of the large quantities of cold-stored and pickled eggs, mainly of foreign but also of British origin,

which are consumed annually by the British public, the report provides much interesting matter for consumers of eggs.

In the beginning of the report attention is drawn to the wide seasonal variation in egg prices, and it is stated that while the average price of home-produced new laid eggs in the wholesale markets was 13d. a dozen in April, 1923 and 1920, it was 42d. a dozen in November of the same years, and that such an extreme range is unknown in the case of any other staple food. The variation in the average production of British eggs is as wide as that of prices. This indicates one of the greatest defects in our present system of marketing British eggs. It is true that the more general attention now paid by poultry-keepers to increasing egg production in the autumn and early winter months is bearing fruit, but the spring glut with its consequent effect upon prices still continues. No doubt the increased quantity of foreign supplies in the spring months of the year also helps to depress prices at this period; still that is another reason why every effort should be made by producers, not only to increase the proportion of their autumn and winter egg output by better methods of breeding and management, but to secure the wider adoption of egg preservation on a large scale, so as to withdraw from the market in the spring sufficient quantities of eggs to lessen the seasonal variation in price which now occurs every year. These variations in price are undesirable in several ways. Not only do producers suffer an immediate loss during glut periods, but when prices rise beyond a certain point in autumn and winter many consumers cease to consume eggs, and having made this change in their daily dietary, are tardy in revising it even when prices fall again.

The preservation of eggs by cold storage is not widely practised in this country, though there are indications that it is growing in favour. It is not improbable that an imperfect understanding of the various factors governing the successful cold storage of eggs has been responsible to some extent for the backward state of the practice in Britain as compared with America, where enormous quantities of eggs are cold-stored every year, some of which find their way to our markets. Messrs. Moran and Piqué deal exhaustively with these important factors; and show that not only does the condition of the egg immediately before storage exercise a vital influence upon its keeping qualities, but that temperature, humidity, quality of air and ventilation, have all to be carefully considered in their bearing upon successful storage. Not only so,

but, as the report points out, much of the benefits of cold storage may be destroyed if the eggs, when removed from storage for disposal through ordinary trade channels, are not properly "defrosted" or, so to speak, acclimatized to outside atmospheric conditions.

Much information is given as to the changes which take place in the egg during cold storage, and it is pointed out that whilst actual chemical changes in the composition of the eggs may be small, the physical changes where storage is improperly carried out may be considerable, and the deterioration of the egg serious. Very helpful suggestions are given regarding suitable cases and trays for eggs in cold store, and these appliances are illustrated by means of drawings. A descriptive illustration of a complete egg storage plant is also included, and there is a most useful appendix to the report dealing with the storage of eggs in water-glass and lime water. These methods of preservation are widely used in this country, and if at some future time Messrs. Moran and Piqué could further investigate them the results of such work would, no doubt, be much appreciated.

Co-operation and Agriculture

AT a recent conference at Cardiff, convened under the auspices of the Western Section of the Co-operative Union, "Co-operation and Agriculture" was the subject of discussion. This is the first of a series of conferences to be addressed by the Agricultural Organizer of the Joint Agricultural Department of the Co-operative Union and the Co-operative Wholesale Society, which was established about a year ago. The Union is interested in the development of all forms of co-operation and is particularly anxious to assist those societies that are already engaged in farming and to bring the farmers' societies and the consumers' societies more closely together. The Co-operative Wholesale Society in its turn is interested in the work of the Department because, as a trading organization, it naturally desires to increase its trade with organized farmers and also to strengthen its relations with the agricultural industry. In his address the Agricultural Organizer called attention to the problems confronting British co-operators and the necessity for increased knowledge of the subject. Success, he said, depended on mutual confidence, patience, and perseverance.

LAND DRAINAGE AND WATER SUPPLY SCHEMES FOR THE RELIEF OF UNEMPLOYMENT, 1925-26

BEING AN ACCOUNT OF THE FINAL SEASON OF UNEMPLOYMENT GRANTS

DURING the autumn and winter, 1925-26—that is, for the fifth consecutive season—the Ministry was enabled to make State grants in aid of land-drainage works and to a limited extent in aid of water-supply schemes, for the relief of unemployment primarily in rural areas, but the total sum available was considerably less than in former seasons. During the preceding four seasons grants were made to drainage authorities as well as (through county councils) to groups of landowners co-operating for mutual benefit ; but during the season under review no grants were made to the former. Drainage authorities were, however, afforded the opportunity of obtaining State aid through the Unemployment Grants Committee, provided that the state of unemployment in the area of scheme works was sufficiently acute to warrant a grant, and that the works could be certified as of public utility. The latter schemes were described in the September, 1926, issue of this JOURNAL.

This account deals, therefore, with the limited number of smaller voluntary schemes undertaken with the assistance of county councils. Approximately £62,600 was spent in the execution of works of land drainage and sea defence, towards which the State contributed about £37,550 ; and about £38,000 was spent on schemes of water supply, towards which grants of about £8,800 were made. On August 22, 1925, all county councils were invited by circular letter to submit schemes to be executed between September 14, 1925, and May 29, 1926, and were notified that this was to be the final season for such grants to be made. There being only limited funds available, it was stipulated that no application could be considered which did not reach the Ministry on or before November 28, 1925, the Ministry reserving the right to apportion the money in such a way as to prevent any area getting an undue share. The conditions laid down were generally those of the preceding years, with one important exception, namely, that the amount to be recovered from landowners, participating in land-drainage schemes, was increased from 33⅓ per cent. to 40 per cent. of the actual net cost. Many more applications for grants were received than

could be financed, and the apportionment of schemes throughout the country presented considerable difficulty. In all 406 schemes were submitted, but only 299 could be approved. Of this number, 44 were subsequently abandoned for various reasons, and, finally, 255 schemes were put into operation.

Weather conditions were, on the whole, much better than in the preceding season: the average rainfall for the period from September, 1925, to May, 1926, was 29·6 inches, comparing favourably with 34·02 inches for the period ending May, 1925, but the rainfall was nevertheless 3 inches in excess of the average of this period for 35 years, and a few schemes were abandoned because of flood conditions.

The Summary and Sketch Map opposite indicate the distribution of the schemes in each of the five divisional areas into which the country was divided for the purpose of supervising the work.

Results.—Reference has been made in each of the previous annual reports of these operations, published in this JOURNAL, to the general nature of the schemes and the valuable results achieved. In many instances it has been possible to link up and extend these small schemes year by year, thus enabling considerable areas to be systematically drained or improved, either by the removal of waterlogging or by the reduction of the periodicity of flooding. One such scheme, which was described in the October (1926) issue of this JOURNAL, is a good example of reclamation by drainage of an area in Lancashire, where, by the aid of grants, peat bog land has been brought into cultivation.

In Northumberland, Cumberland and Durham large areas of rough sheep-grazing lands have been drained by a network of open ditches and made healthier for stock. Improvements to pasture land have been effected all over the country, and a scheme of this type in Herefordshire is worthy of mention in detail. The following notes upon it have been supplied by Mr. Greville H. Phillips, Chief Agricultural Officer and Land Drainage Surveyor to that county, and the operations are described by him as under:—

Letton Lakes Drainage.—This scheme is one of the most important that has been carried out in Herefordshire for many years and has caused considerable local interest. The conditions obtaining before it was undertaken were typical of the evil

STATISTICAL SUMMARY AND DIVISIONAL AREAS

No. 1 Hunts, Cambs, Bed, Norfolk and Suffolk

„ 2 Wales and Shropshire, Worcester, Stafford, Warwick, Hereford, Monmouth

„ 3 Northumberland, Durham, Cumberland, Westmorland, Yorks, Lancs, Cheshire, Derby, Notts, Lincs, Leicester, Rutland and Northants

„ 4 Wilts and Somerset

„ 5 Essex, Kent, Middlesex, East and West Sussex, Oxford, Berks, Gloucester, Bucks, Herts, Surrey, Hants, Dorset, Devon and Cornwall

Area No.	Number of Schemes			Totals	Number of man-days worked	Approximate expenditure				Approximate acreage benefited or protected from inundation
	Drainage	Sea Defence	Water Supply			Drainage	Sea Defence	Grants in aid of water supply	Totals	
						£	£	£	£	
1	13	—	—	13	13,314	5,473	-	—	5,473	7,370
2	62	-	1	63	33,738	15,510	—	22	15,532	23,102
3	54	1	4	59	83.806	16,105	1,120	548	7,773	26,890
4	30	-	42	72	57,052	10,605	-	6,458	17,063	37,325
5	29	5	14	48	30,821	5,907	7,865	1,734	15,506	9,085
Totals	188	6	61	255	218,731	53,600	8,985	8,762†	71,347	103,772
						$\underbrace{}_{\text{£62,585}}$				

† Includes only Ministry's grants for effective cases.

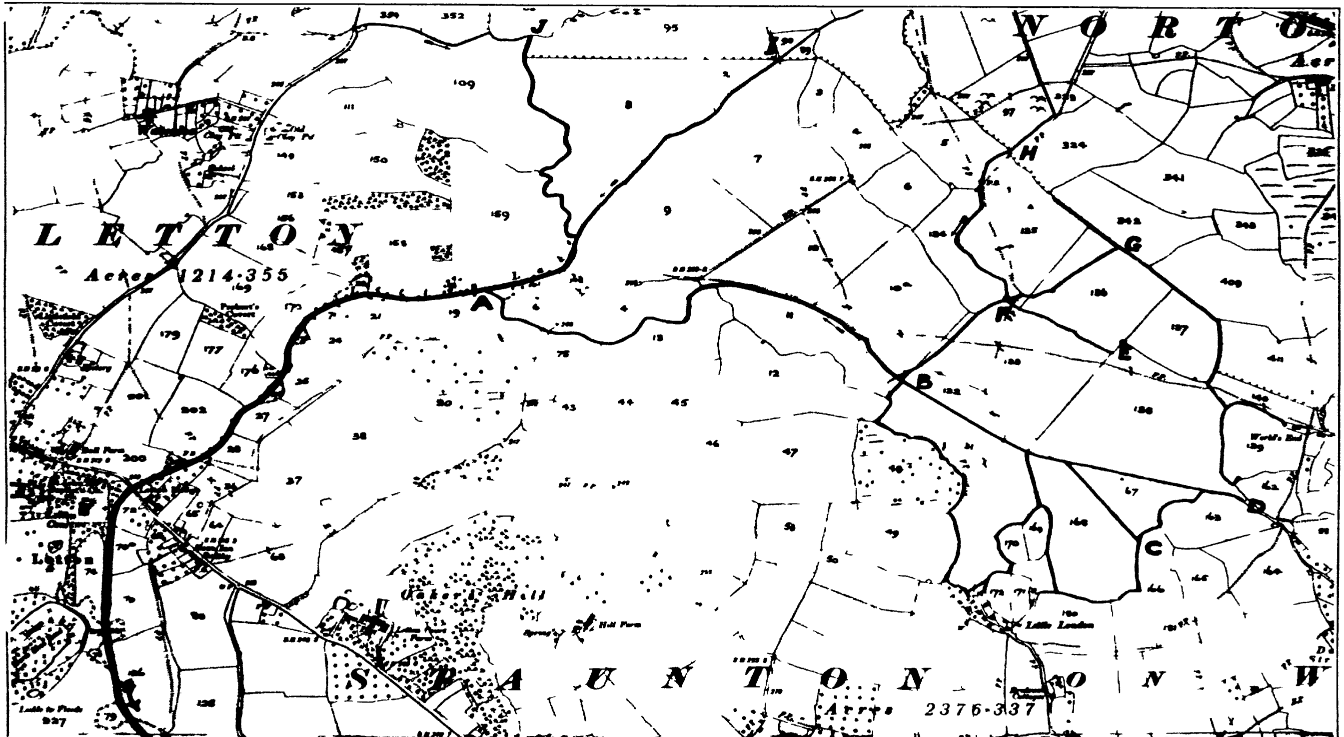
results which follow neglect to maintain in working condition drains and streams over an area of land.

The parish of Letton lies due west of the city of Hereford, eleven miles on the main road towards Hay. A small tributary of the Wye, called " Letton Lake," drains that parish together with portions of Staunton-on-Wye and Norton Canon. In Old English, the word " Lac " or " Lake," when used as a place name, has not the meaning of the modern word. It was applied indiscriminately to a running stream as well as a standing pool. For instance, " Bab-lock-hithe," in Oxfordshire, in 1291 became "Babblelake"; a stream in Wigmore, Herefordshire, is " Wigmore Lake " on the 1831 map ; and another in Sutton, Herefordshire, is " Sutton Lake." On the old tithe map the name " Letton Lake " is given to the stream itself, but in the district " Letton Lakes " is used to describe an area of land, which, drained by the stream and its tributaries (see sketch map), is low-lying land, mainly pasture, about 1,650 acres in extent, in many places covered with sedges, rushes and tussock grass, and wet and boggy. For many months in the year much of it was under water.

That a carefully planned drainage scheme for improving this land had been carried out at some time in the past is clearly shown by comparing the old tithe map with the present Ordnance map. In the tithe map of 1840 the stream is shown as following a narrow, winding course, full of twists and bends. On the Ordnance map the present course of the stream is shown to be comparatively straight, with easy bends and a good outlet into the River Wye just below the well-known Letton Court, one of the country mansions recently destroyed by fire and now being rebuilt.

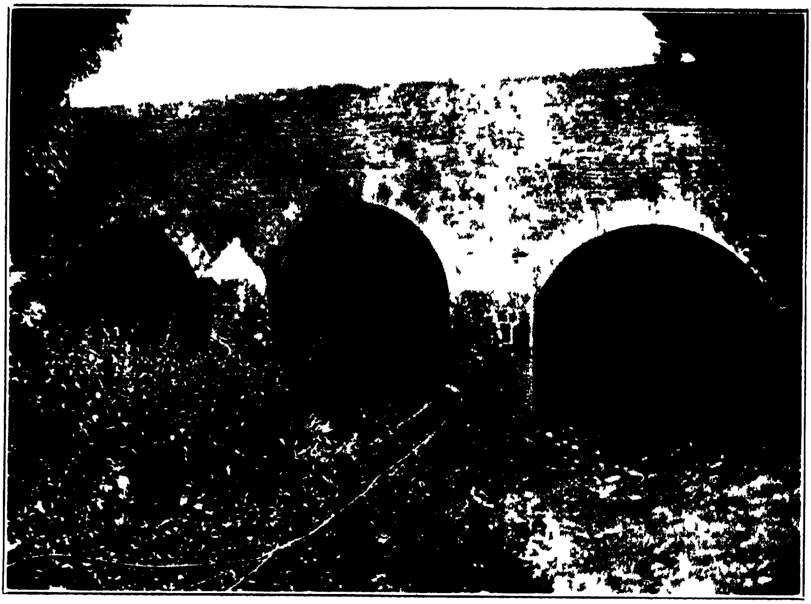
In searching through the papers of the Garnons Estate for plans or details of this improvement scheme Mr. Murray Thompson, agent for Sir John Cotterell, Bart., came across some old correspondence which led to the discovery of the fact that a charter dated November 21, 1863, had been granted and that a Commission of Sewers for the area had been set up at that date. It was also ascertained that new commissioners were appointed by royal warrant as late as 1888.

From the correspondence available it would appear that the original charter gave very wide powers ; and the commissioners were entitled to levy a rate for the repair or renewal of the fencing and for scouring the stream periodically after the initial scheme of improvement was completed. Apparently the first work undertaken after the granting of the charter was



Sketch map of Letton Lakes Stream and tributaries

(The outfall [illegible] the River Wye [illegible] at Letton [illegible] letter [illegible])



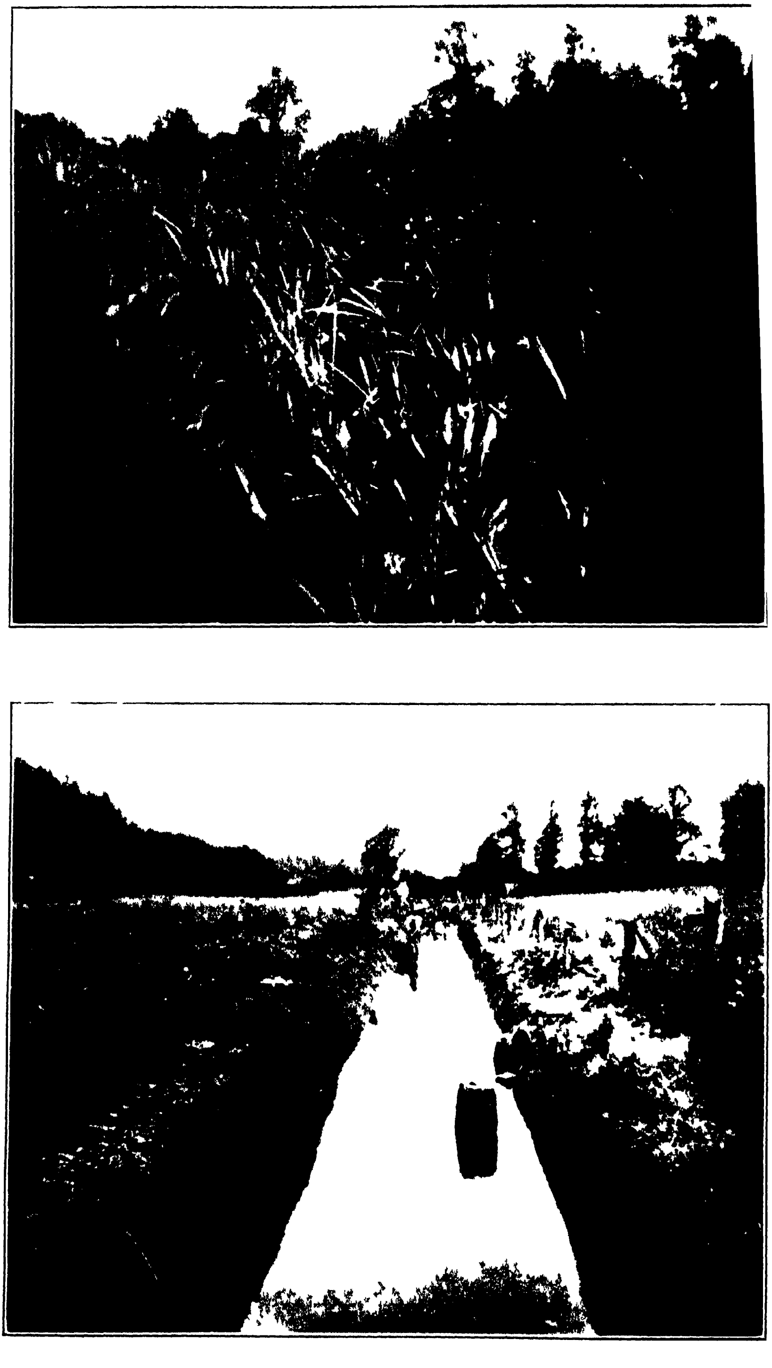
Letton Bridge before and after the execution of the works

Letton Lakes Drainage Scheme

Culvert in Field 132
(The white mark on the right abutment shows level of the mud before clearing.)

Stream in Field 136. Before and after clearing
(The piece of white paper is being held in the same position in both views.)

LETTON LAKES DRAINAGE SCHEME.



The River Bliss before and after clearing

A Wiltshire Drainage Scheme

in the years 1863 to 1865 and consisted of cutting through the bends and straightening the main course for a distance of about 1½ mile from the mouth to the point " A " (see sketch map) where the stream divides into two tributaries ; and widening, deepening and regrading the section " A—B " with a sufficient fall to allow for the draining of the new cuts " B—C " and " B—D," which are referred to later.

At the point " B," known as the Ash Beds, the stream turns almost due north finally to divide, at " F," into three smaller arms, and these in places were also deepened. Although no plans of the 1863 improvement scheme can be traced, it appears from the old tithe maps and observations made upon the ground that the streams mentioned constituted all the drainage at this date, though possibly there was a small ditch running due south from " B " (the Ash Beds) which carried surface water away from the hamlet of Little London. It is practically certain that the arms " B—C " and " B—D," if they existed at all at that date (which is very doubtful), were only small field ditches. All the evidence goes to show that they were new cuts made to take the flood water from the upper lands at World's End and Little London and to provide a short and more direct outlet into the main stream for some old stone drains which existed on the adjoining property, the outfall from which was travelling by a long and circuitous course to a point about a quarter of a mile above the junction at "A." The section " B—F " and its branches were also deepened and widened. The other two tributaries on the left of the main stream, " A—J " and " A—I," also received attention, but, as these had a fairly good natural fall, little new work was attempted by the commissioners.

In 1887 the old stone under-drains on the Garnons Estate were replaced by pipe-drains, and a considerable amount of other pipe-draining was also done, the outfalls all voiding into one or other of the improved streams or new cuts made in 1865. Although some twenty years elapsed between the carrying out of these two works, it would appear that the two improvements were planned at the same time and by the same mind, for the whole scheme forms a remarkably clever and complete system of drainage for an area of approximately 2,000 acres of land.

Up to the year 1890 the stream was kept scoured and cleaned and the fencing in repair, rates being levied from time to time for this purpose. In October, 1891, there is a record

of a meeting of the "Letton Drainage Commission" being held at the Shire Hall, Hereford, at which it was resolved not to ask the commission to raise money by rate for the purpose of clearing the brook of undergrowth and obstructions. There was also a discussion whether the commission should be dissolved or not, but it was resolved that it should continue, although from this date apparently little if anything has been done to maintain the work. The powers of the old commission appear to have fallen into abeyance and it was not until the present scheme was nearly completed that the old papers were found which led to the discovery of the original charter.

In 1919 surveys were made by the War Agricultural Committee with the idea of setting up a Drainage Board or carrying out a scheme under the Land Drainage Act. Nothing, however, was done until 1925, when the condition of the land decided the owners and occupiers to unite in an effort to carry out a scheme, if a grant could be obtained through the Unemployment Relief Fund. The land was again surveyed and a scheme, estimated to cost £700, was formulated and submitted to the Ministry. It was difficult to arrive at an estimate for carrying out the work during the winter months because progress was necessarily governed by the condition of the River Wye, a slight rise in which would block the mouth of the lake and hold up water for some distance. The Wye frequently rises six to ten feet in a day! About three-quarters of a mile from the mouth the stream is spanned by Letton Bridge, a fine old stone structure erected, according to the inscription thereon, by "J. F." in 1769. The bridge consists of three arches, two of which span the stream itself, the third forming an additional flood arch. The fall from this point to the River Wye is 3 ft. 9 in., or one inch in 83 feet. When the first inspection was made only one arch was functioning properly, the second and flood arches being silted up with mud and debris, the whole forming a very effective dam. Above the bridge the main stream was blocked by fallen willow and alder trees, and, as many of these had taken root and were growing, the condition can be better imagined than described. From the junction "A" to Letton Bridge the total fall is 3 ft. 4 in., or one inch in 100 feet. It will be appreciated therefore that the blockage at Letton Bridge had disastrous effects upon the upper reaches of the stream, and held up a huge volume of water which could only spread itself

over the adjoining land, remaining until evaporated during the course of the summer.

The Ministry having approved the scheme, work was commenced on December 9, 1925, with 22 men. It was decided to commence operations at the mouth, first removing all the fallen trees from the stream as far as Letton Bridge. No attempt could be made at this stage to clean out and regrade the bed, the volume of water held up being so considerable as to render it impossible for men to work in the stream even in waders. The method employed was to cut away the bushes and undergrowth on the banks, then to haul out the fallen logs, etc., and finally to pull out with drags, etc., as much of the growth and debris as possible. Some of the tree stumps required all the 22 men to haul them out, no horses being used at all. The stream having been roughly cleared as far as the junction "A," it was possible to see the effect upon the upper reaches. It was found as a matter of fact that the northern tributary, "A—I," was not in such a bad condition as had been expected and that the clearance of the main stream enabled the water to flow off fairly readily. It was decided, therefore, to leave this arm for the time being and keep the men together in one gang on the eastern tributary, "A—B." The average fall in this section is 1½ inch in 200 feet.

Considerable difficulty was experienced in this section and for two weeks very little progress was made. In addition to the overgrowth and the fallen stumps the stream was found to be so badly silted up and so much trodden in by cattle that nothing less than the removal of two or three feet of mud would have any effect. The only outlet for the large volume of water lying out upon the lands was through the stream where the men were working, which varied from four to 12 feet in width. It was obviously impossible for the men to do effective digging in two or three feet of water, and the only thing to be done was to stop the rush of water and leave the men free to work. Six-foot sheets of corrugated iron were procured and vantage points chosen where these could be inserted as stanks across the stream. It was found that one stank was not sufficient to hold back the water for any appreciable length of time, and three had to be put in at a distance of about 100 yards apart. In the beginning these would hold back the water for about two or three hours and then the pressure would swamp the first, the second and third being pulled up to allow the water to get away. As soon as the stream had cleared, the stanks were again inserted and the

men proceeded with the work. On one or two occasions the stanks gave way unexpectedly, and the gang had to make a hurried exit from the stream. Luckily there were no accidents, although on one occasion four men were nearly overwhelmed by the rush of water.

As the men worked up stream and the water dropped (an average lowering of three feet in water level was obtained) the stanks were inserted in the morning before the gang came to work and held until mid-day, when they were removed and the accumulated water allowed to flow off, a second series being inserted in time to block the stream for the men to commence operations in the afternoon. So bad were the conditions in this section that twice the work was abandoned and the men put on lighter tasks temporarily. Eventually, however, it was completed, and the main difficulties were now overcome. The stream being comparatively clean from point "B" to the mouth, the water was able to get away freely, and the upper fields dried rapidly. The men were divided into small gangs and the work proceeded apace. In turn the various cuts and ditches were tackled until all were completed. Fortunately Sir John Cotterell's agent was in a position to produce plans upon which the position of the main outfalls of under-drains were marked, and, although the majority of these had been covered for many years, all were uncovered and are now in working order.

Some idea of the quantity of mud and debris removed in these upper reaches can be formed by a glance at the view of the culvert in Field No. 132. The excavated mud has dried almost white and the figure in the picture is pointing to a mark upon the culvert which shows the level of the mud before work commenced, the water flowing mostly over and around the arch. The banks were protected by barbed wire as soon as the work was completed. It is of little use spending large sums of money upon this class of work unless the precaution is taken of preventing the spoil being pushed back into the stream by the treading of cattle. Most of the trouble in the upper reaches has been caused by the failure to protect the ditches, and as a result the cattle have trodden them in until they were completely filled up.

A considerable set-back was experienced in April this year, when a section of the bank between Letton Bridge and the River Wye, some 120 yards in length, began to cave in at a point where the sides are some 15 feet deep. All the men had to be sent back and two rows of 10-foot piles were driven in to

hold up the sides. Apparently this difficulty had been experienced when the previous operations were carried out, for in places the old piles were discovered. Where completely covered by water they were in an excellent state of preservation and as far as possible were left untouched to perform the work for which they were originally inserted. In spite of the many difficulties experienced the work was completed within nine days of the scheduled time and within £20 of the original estimated cost. The benefit to the lands in the upper sections is already very apparent, stock being turned out to graze several weeks earlier than has been possible for many years past. Provided the barbed wire fences protecting the cuts are maintained and a small amount of labour put in each year to keep the cuts clean from the overgrowth, there is no reason why the work which has now been done should not be maintained at very little cost for many years to come.

DETAILS OF THE LETTON LAKES SCHEME

Length of various sections :—	
Mouth to Letton Bridge ..	3,500 feet.
Letton Bridge to "A" ..	3,940
to "B"	4,500
to "C" and "D" ..	4,290
to "F"	1,300
to "F," "G" and "H"	4,010
to "I" and "J" ..	6,260
Subsidiary or other streams	11,620
	39,420 feet, or about 7½ miles.

Date of commencement of work. December 9, 1925.
Date of completion of work, June 5, 1926.
Total time occupied, 26 weeks.
Cost of scheme, £725.
Number of men employed, from 18 to 22.
Length of barbed wire fencing erected, 5,217 yards.

Water Supply Schemes.—Sixty-one schemes of water supply were executed, chiefly in the counties of Wiltshire and Gloucester. The work included the excavation and deepening of wells and reservoirs, sinking of bore holes, provision of pumps, rams, pipe-lines, drinking troughs, etc. The Ministry's grants covered only the unskilled labour costs in these cases, but actual expenditure on materials and skilled labour was, at least, three times the amount of the grant.

Generally.—Two of the illustrations, accompanying this article, illustrate a scheme carried out in Wiltshire, a county which has been particularly active in making good use of these unemployment grants for water supply and land drainage.

It is satisfactory to record, in the last of a series of annual

articles dealing with the expenditure in the aggregate of a large sum of public money, that county councils are now empowered by means of the Land Drainage Act, 1926, to secure the maintenance of the drainage works executed through their agency, and also to undertake small schemes in suitable cases. There is, therefore, a reasonable prospect that the pioneer work which has been done will be further extended, and that the drains will not be allowed to relapse into the conditions prevailing for so many years past.

It is possible that the Act of 1926, where intelligently and thoroughly applied, will lead to an increasing area of land being freed from waterlogged conditions, particularly where the primary cause is sheer neglect to cleanse drains and water-courses; and is aggravated by the reluctance of farmers to appreciate the valuable results to be achieved through co-operation in land drainage schemes.

In conclusion, the following statement may be of interest, showing as it does the total cost of the effective land drainage, sea defence and water supply schemes carried out with financial assistance from the Ministry in the course of the five seasons during which these grants have been available, together with the amount of the State's contribution, based on the specific conditions in force during each season.

It must be understood, however, that the final accounts for a large number of the schemes carried out during the last season have not yet been received, while in certain other cases accounts are still subject to adjustment, and for this reason it is not possible to give other than estimated figures for this season. Estimated figures have also had to be given for the

Season	Drainage and Sea Defence				Water Supply		Total	
	Drainage Authorities		County Agricultural Committees		County Agricultural Committees			
	Total net cost	Govt contribution	Total net cost	Govt. contribution	Total net cost	Govt contribution	Total net cost	Govt. contribution
	£	£	£	£	£	£	£	£
1921–2..	239,231	170,423	79,206	51,658	28,832*	10,136	347,269	232,217
1922–3..	248,747	185,839	84,684	56,106	37,996*	11,213	371,427	253,158
1923–4..	178,956	134,217	84,535	55,578	41,599	10,929	305,090	200,724
1924–5..	152,742	114,556	74,937	49,946	38,828	10,162	266,507	174,664
1925–6..	—	—	62,585*	37,550*	38,000*	8,762*	100,585*	46,312*
Total..	819,676	605,035	385,947	250,838	185,255	51,202	1,390,878	907,075

* Estimated figures only.

total cost of water supply schemes carried out during the 1921-22 and 1922-23 seasons.

As already indicated, the statement takes into account only effective schemes, that is those actually carried out and completed wholly or in part. A certain amount of expenditure was incurred by county agricultural committees during each of the five seasons, in connexion with schemes which, for one reason or another, had to be abandoned, either after submission to the Ministry or before they reached that stage. As neither the committees themselves nor the county councils had any funds from which such expenditure could be met, it had to be borne entirely by the State.

REPORT ON AGRICULTURAL EDUCATION IN THE FINANCIAL YEAR 1924-25

IT is the Ministry's intention to issue as soon as practicable a report on the work of the Intelligence Department during the two years 1924-26, in continuation of the report published last September, dealing with the work of the three years 1921-24.* Thereafter it is hoped to publish the Intelligence Department report annually. Pending the completion of the report for 1924-26—the complete statistics for which will not be available for a few months—it is thought that a report on the Ministry's activities in connexion with agricultural education for the year 1924-25 (the last for which full statistics are at present available) may usefully be published.

The educational work of the Ministry is divisible into three broad sections. In the first place, higher and intermediate agricultural education is provided by universities, agricultural colleges, and county education authorities, largely by means of State grants ; it is the Ministry's duty to see that this money is well expended, that educational facilities are made available as far as practicable throughout the country, and that the whole system is co-ordinated and properly conducted. Secondly, in the more specialized fields of horticulture, dairying and small livestock (chiefly poultry-keeping), the Ministry endeavours to keep in touch with the trend of industrial development, and to stimulate the carrying out of educational measures likely to be of immediate value to agriculturists. Thirdly, the scholarships provision which has been made available by local education authorities—and

* *Report on the Work of the Intelligence Department of the Ministry for the Three Years* 1921-24. (H.M. Stationery Office, 5s. net.)

to a minor extent by other bodies—has been supplemented in certain important directions by the Ministry, and these schemes are administered direct by the Department. In addition, a few miscellaneous schemes, educational in character, are organized by the Ministry, and will be referred to in this account.

The report hereunder is accordingly divided into (1) higher and intermediate agricultural education, including the work of local education authorities, and the farm institute scheme; (2) educational schemes specially applicable to the dairying and small livestock industries, *i.e.*, apart from general education dealt with under the previous heading; (3) scholarships and training schemes. In each case only the briefest outline of the Ministry's activities during the year in question is possible.

I.—AGRICULTURAL EDUCATION

Higher Agricultural Education at Universities and Agricultural Colleges.—During 1924-25 the "block" maintenance grants which had been paid since the year 1919-20 were continued, as follows:—

University College of Wales, Aberystwyth	£3,800
University College of North Wales, Bangor	3,800
Cambridge University, School of Agriculture	5,700
Leeds University	3,800
Armstrong College, Newcastle-on-Tyne	3,300
Oxford University, School of Rural Economy	3,300
Reading University	3,500
Reading University, British Dairy Institute	900
South-Eastern Agricultural College, Wye	4,400
Harper Adams Agricultural College	4,400
Midland Agricultural and Dairy College	2,500
Royal Agricultural College, Cirencester	2,000
Royal Veterinary College	3,300
Seale-Hayne Agricultural College	2,300
Swanley Horticultural College for Women	1,500
	£48,500

In addition a grant of £555 was paid to the Harper Adams College in respect of the maintenance of the National Institute of Poultry Husbandry (referred to under the National Poultry Institute Scheme) during the latter part of the year 1924-25. The normal grant for a full year is estimated at £2,000.

The number of students attending the above institutions remained at approximately the same level as in the previous year. The figures for four years are interesting:—

1921-22	2,378 students.
1922-23	2,190 „
1923-24	1,918 „
1924-25	1,911 „

Of the 1,911 students who attended higher institutions during the year under review, 459, or nearly 25 per cent., were taking short courses, and 1,452 were taking the longer courses, leading to certificates, diplomas and degrees. Of this number, 341 were degree students (excluding veterinary).

The teaching side of the higher educational institutions represents, however, only one phase of their activities. Of late years, and particularly since the war, an increasingly important advisory side has been developed, mainly in the case of those institutions which serve as "provincial centres" for a group of counties. No fewer than 64 advisory officers, appointed by means of special grants from the Ministry, are now at work at centres for higher agricultural education, and the specialist advice which these officers are able to put at the disposal of farmers is, of course, supplemented by the extra-mural activities of the other members of the college staff. For obvious reasons it is difficult, by figures, to give an adequate idea of the services thus rendered to agriculture; but it may be said that during 1924-25 advice, either by personal visit or by letter, was given in from 15,000 to 20,000 cases, while approximately 40,000 samples of milk, fertilisers, feeding stuffs, etc., were analyzed for farmers for advisory purposes.

One further important function of the provincial centres may be referred to, *viz.*, that of acting as local co-ordinating bodies for experimental and advisory schemes whose scope properly extends beyond that of the normal educational unit, the county. One of the drawbacks inherent in a scheme of local government and responsibility is that county boundaries do not coincide with those of climate and soil. In consequence, economy of effort in experimental work can only be attained by co-operation, but co-operation between counties, which may involve some sacrifice of individuality, is not always easy to secure. Co-ordinating centres, where schemes applicable to a larger area than one county can be conceived and planned, and where the results can be discussed and compared, are required to meet this difficulty. The Ministry has encouraged the policy of regarding the provincial educational centres as clearly fitted to undertake this responsibility, and it is satisfactory to be able to record that in the majority of provincial areas periodical conferences of college and county officials are held, and joint schemes carried out. In one or two areas the scheme of provincial conferences has yet to be put into full operation, but it is hoped that before long these gaps will be filled.

Finally, a note may be made of the position of the building schemes at some of the institutions for higher education. The new buildings for the Agricultural Departments of Bangor and Leeds are now approaching completion; during 1924-25 grants of £4,565 were paid to Bangor and £4,070 to Leeds, as instalments of the total grants not exceeding £15,000 (on a £ for £ basis) sanctioned in each case. The scheme for the provision of additional accommodation at University College, Reading,* was completed during the year, and a final payment of £752 made, making a total grant of £2,727. The reorganization of farm buildings at Seale-Hayne College, towards which the Ministry sanctioned a grant of £5,500, was also completed, and instalments of £1,400 were paid. Swanley Horticultural College was also in process of effecting extensions and improvements; the scheme was completed during the year, a final payment of £108, making a total grant of £1,448, being made by the Ministry, as well as a grant of £1,850 to meet contributions of a similar amount from outside sources for the purpose of reducing a portion of the mortgages which have hampered the free working of this institution. A grant of £1,275 was also paid to the Midland Agricultural and Dairy College, as the Ministry's contribution towards the cost of transferring the poultry department from Kingston to Sutton Bonington. This expenditure is met by the counties contributing to the college, and is aided by the Ministry under the regulations governing grants to local education authorities.

Agricultural Education provided by Local Education Authorities.—The general lines on which agricultural education is conducted in the counties and aided by the Ministry are already sufficiently well known; apart, therefore, from a few introductory remarks, this report is confined to noticing the main developments that took place during the year 1924-25.

All approved work is aided by the Ministry under its Educational Grant Regulations, the rate of grant being 66⅔ per cent. of the expenditure, except in the case of the salaries and expenses of agricultural organizers and certain horticultural superintendents, of which the Ministry contributes 80 per cent. Capital expenditure on the establishment or extension of a farm institute is aided at the rate of 75 per cent.; the purchase of land is aided at 66⅔ per cent., either by direct grant, if the cost is met from revenue, or, if the

* Now the University of Reading.

money is borrowed, by allowing the loan service charges to be included in the authority's annual claim for grant. The local authority is required to submit, before the beginning of the financial year, an estimate of the expenditure proposed to be incurred during the year; if approved by the Ministry, an instalment of the grant payable accompanies the letter of approval, which issues as soon as possible after the beginning of the year. Half-way through the year a further instalment is paid, on receipt of a formal application by the authority accompanied by a statement of actual expenditure for the first half year and of estimated expenditure for the second half. The balance of grant is paid after receipt of the audited accounts for the year, supported by a fairly detailed summary of the work that has been carried out.

The following figures show the expenditure of county authorities on agricultural education during the past few years :—

Year	Expenditure			Grants		
	England	Wales	Total	England	Wales	Total
	£	£	£	£	£	£
1920-21 ..	230,097	29,600	259,697	152,992	20,429	173,421
1921-22 ..	235,401	35,329	270,730	156,560	24,321	180,881
1922-23 ..	194,573	31,340	225,913	129,266	21,830	151,096
1923-24 ..	188,228	35,783	224,011	125,291	24,823	150,114
1924-25 . (approx.)	227,000	37,000	264,000	151,000	26,000	177,000

In addition, in 1924-25 capital grants totalling £16,478, representing 75 per cent. of an expenditure of £21,972, were paid in connexion with the provision or extension of farm institutes.

The figures for maintenance expenditure, given in the above table, afford no indication of the rate of development of county work, inasmuch as they include "non-recurrent" expenditure (*e.g.*, the purchase of a farm from revenue), which of course may fluctuate considerably from one year to another. A more reliable guide is to be found in the statements showing the number of instructors employed by local authorities. These reveal considerable progress, which is the more satisfactory bearing in mind that agriculture has not been flourishing and that local authorities have been struggling to reduce the rates. When the last report of the Intelligence Department was issued, in September, 1925, the total number of whole-

time instructors and instructresses employed was 293. This number has now risen to 324, as follows :—

Agricultural organizers	49 in	53	counties
Agricultural instructors (including chemistry, botany, zoology, etc.)	77 ,,	31	,,
Horticulture	77 ,,	54	,,
Dairying	47 ,,	28	,,
Poultry keeping	36 ,,	33	,,
Dairying and poultry-keeping (combined) ..	23 ,,	20	,,
Farriery	6 ,,	6	,,
Bee-keeping	3 ,,	3	,,
Veterinary science	2 ,,	4	,,
Farm accounting	2 ,,	4	,,
Manual processes	2 ,,	2	,,

There are still two counties, *viz.*, Bedford and Soke of Peterborough, where no whole-time agricultural education staff are employed. In seven others there is no agricultural organizer, *viz.*, Isle of Ely, Huntingdon, Middlesex, Norfolk, Isles of Scilly, West Suffolk, Isle of Wight. In Norfolk, however, the duties of an agricultural organizer are in part carried out by the Director of the Norfolk Agricultural Station.

With regard to the instructional work of county staffs, as distinct from their advisory duties, the following statement is significant :—

STATISTICS OF ATTENDANCE AT COURSES RECOGNIZED UNDER THE MINISTRY'S REGULATIONS

	1921-22	1922-23	1923-24	1924-25
Farm Institute, etc., Courses				
No. of courses	38	56	63	68
No. of students ..	567	720	652	759
Organized Day Courses				
No. of courses	3`5	321	310	322
No. of students ..	3,788	3,295	3,003	3,023
Evening Classes				
No. of courses	278	284	305	295
No. of students ..	5,402	5,824	6,782	6,116
Correspondence Courses				
No. of courses	—	—	—	5
No. of students ..	—	—	—	73
*Instruction in Agricultural Manual Processes**				
No. of courses	94	104	112	141
No. of students ..	835	874	824	1,234
Lectures, Demonstrations and other Meetings				
No. of meetings	7,966	7,701	7,478	8,376

* Ploughing. hedge-laying, ditching, thatching, sheep shearing, basket-making, hurdle and spar-making, milking, etc.

The progressive increase in farm institute instruction is due of course to the opening of new institutes, and it is interesting to note that this development has not been attended by a serious diminution of the provision of organized

day-course facilities. The figures also reflect a growing interest in the question of improving the skill of farm workers. The Ministry has recently urged still further attention to this aspect of agricultural education. Another interesting feature brought out in the table is the introduction of a scheme of instruction by correspondence. Five counties tried this scheme as an experiment, and on the whole it has so far been successful. Its value is, of course, strictly limited ; but it serves at least to stimulate interest in up-to-date methods, and may be the means of reaching students who would otherwise be unprovided for.

Scholarships.—The provision of agricultural scholarships by local authorities has been gradually extending in recent years, as the following figures show :—

Year	Number awarded	Amount expended
1921-22	914	£14,505
1922-23	945	£13,370
1923-24	1,012	£11,232
1924-25	1,214	£12,617

The scholarships vary from the remission of small fees for classes to the award of long-course university scholarships. In addition to this provision, the Ministry itself administers certain scholarship schemes, which are referred to on p. 727.

General.—There was a considerable increase in farmers' discussion societies in 1924-25, some twelve counties taking up the scheme. The value of this form of educational activity was referred to at some length in the last report. Another question that merits a reference here is that of agricultural demonstrations. The Ministry circularised local authorities on this subject early in 1925, suggesting the need for large-scale demonstrations of improved methods of farming in districts where such improvement appeared to be required. Such demonstrations might be arranged in co-operation with local farmers, and would be more in the nature of propaganda than of experiments. The response to this suggestion has not been as great as was anticipated : possibly because of local difficulties, or because the time of the agricultural staff is already fully occupied. Where circumstances permit, however, the Ministry feels that the introduction of improved methods by such demonstrations, conducted on a commercial scale and judged by the profit and loss account, would form a valuable " final link " in the chain by which science is brought into the domain of practical farming.

It is convenient to mention here certain schemes of a "national" character which have been controlled directly by the Ministry, but depend for their operation partly or entirely on the co-operation of local education authorities. Prominent amongst these is the young farmers' club movement, the oversight of which was accepted by the Ministry in October, 1924. An inspector was appointed early in 1925 to take charge of the scheme, and through his efforts a considerable growth has taken place, as the following figures show :—

YOUNG FARMERS' CLUBS

Year	No. of counties	No. of clubs	No. of members
1924	8	13	254
1925	12	21	520
1926 .. .. (October)	15	56	1,415

The young farmers' club movement attracts boys and girls at an age which is often a turning point in their lives; hence the Ministry regards it as a valuable means of stimulating the young to an interest in a rural career, and as such commends it to the favourable notice of local education authorities.

The Ministry is also instrumental in arranging demonstrations or lectures throughout the country on subjects which are regarded as sufficiently important to justify such action. In 1924-25 a series of demonstrations in mole plough draining with a tractor-drawn mole plough was held, and has been continued in subsequent years; the demonstrations have been conducted under the auspices of the county education authority, with assistance from the Ministry's Machinery Adviser. They have been successful in bringing about a renewed interest in this form of drainage, which has many advantages in suitable districts owing to the relatively low labour costs. In 1924, also, a blacksmith's demonstration van was purchased and equipped by the Ministry in conjunction with the Rural Industries Bureau, to lend to county education authorities for itinerant work amongst blacksmiths, the object being to demonstrate up-to-date methods of farriery work and acetylene welding. A second van was acquired for the same purpose in July, 1925; both vans have been continually at work, and have proved a valuable means of stimulating a rural trade which has been in some danger of declining. Mention should also be made here of a series of twenty lectures on the breeding and feeding of pigs for bacon, given during the winter of 1924-25 by Professor C. Crowther, M.A., Principal

of Harper Adams Agricultural College, and Mr. W. A. Stewart, M.A., Principal of the Moulton Grounds Farm Institute. These lectures were delivered at twelve centres, and were intended to guide producers—and particularly the suppliers of co-operative bacon factories—on the production of a more uniform type of bacon pig.

In the sections dealing with dairying and small livestock reference will be made to other national schemes which have been initiated or encouraged by the Ministry. It only remains to add here that the policy of securing co-ordination of work was extended in several directions during the year. The importance of provincial conferences, between the college and county educational and advisory staffs, has already been mentioned ; in 1924-25 twenty-three such conferences took place. In the summer of 1924 a four-day conference for agricultural organizers and others interested was held at the School of Agriculture, Cambridge. The subject dealt with was " Animal Nutrition " ; about sixty persons attended, and the papers and discussions were interesting and instructive. A full report of this conference appeared in the Ministry's JOURNAL for October, 1924. As a further means of promoting co-operation, the Ministry arranged conferences of dairy and poultry-keeping instructors in London during the Dairy Show week. These meetings were much appreciated, and have been repeated in subsequent years.

Progress of County Work.—The following are brief notes of the extensions of county systems of agricultural education which occurred during 1924-25 :—

ENGLAND

Cheshire.—The scheme for concentrating the authority's agricultural education activities at Reaseheath made progress during the year. The greater part of Henhull Hall Farm was sold and arrangements were made to terminate the lease of Worleston Dairy Farm (vacated during the spring of 1926). Work on the new dairy and women's hostel at Reaseheath was commenced.

Cornwall.—Two additional assistant agricultural lecturers were appointed to meet the demand for instruction at evening classes. About 350 young people attended such classes during the winter of 1924-25. Motor transport was used to bring the students to the centres of instruction, the authority refunding two-thirds of their expenses in this connexion.

Cumberland and Westmorland.—A new poultry station was established at the Newton Rigg Farm School.

Devon.—A fourth district lecturer in agriculture was appointed.

Essex appointed a commercial horticultural instructor.

Gloucester.—The heavy demand for instruction and advice in poultry-keeping led the authority to appoint an assistant instructor in this subject during the year.

Herts appointed a resident teacher of agriculture at Oaklands Farm Institute to undertake cost accounts for its various departments.

Hampshire.—Progress was made on the building of a new hostel.

Isle of Wight.—The authority made arrangements with the Hampshire County Council whereby in return for a maximum grant of £200 the staff of the Sparsholt Farm Institute carried out instructional and advisory work in the Island. Courses were provided by the Hampshire Travelling Dairy School over a period of six weeks, and twelve lectures in miscellaneous agricultural subjects were also given.

Lincs. (Holland).—The county Farm Institute (non-residential) at Kirton was opened in the autumn of 1924.

Middlesex.—A dairy and poultry instructor was appointed.

Northumberland.—An agricultural organizer and a poultry instructor were appointed in the autumn of 1924.

Somerset.—A county lecturer in agriculture was appointed to develop instructional and advisory work outside the Farm Institute.

Sussex, East.—The authority purchased Wales Farm (previously rented by them as a demonstration centre) for £9,604, as a preliminary to the erection of a farm institute thereon.

Yorkshire.—The vacant professorship of agricultural chemistry at Leeds was filled by the promotion of Dr. N. M. Comber, then senior lecturer on agricultural chemistry and advisory chemist. An assistant lecturer in agricultural economics was appointed. The Osgodby Fruit Plot was extended by four acres of land, which was rented by the authority for development as a sub-station for testing new varieties of fruit trees under the Ministry's scheme.

WALES

Anglesey.—The county incubating station was removed to new premises and its operations extended. The property cost £2,000, and £518 has been spent in adapting the buildings and providing extra equipment and in establishing county egg-laying trials.

Brecon and Radnor.—A fruit demonstration plot was established on a statutory small-holding near Builth Wells.

Carmarthen.—Proposals involving £14,330 for the erection and equipment of educational buildings for the Pibwrlwyd Farm Institute were approved. Sanction was also given to certain improvements in the farm buildings.

Denbigh.—An assistant instructress in dairying was appointed. Proposals were approved for enlarging the hostel at the Llysfasi Farm Institute and providing a new house for the Principal, at a total cost of about £4,000: also for improving the farm buildings at a cost of £2,554.

Glamorgan.—An instructor in dairying and poultry husbandry was appointed. Property near Bridgend with forty-one acres of land was acquired at a cost of £6,300 for the purposes of a demonstration farm and for use as a non-residential dairy school.

The County Borough of Swansea adopted a scheme for the provision of instruction in agricultural subjects, more especially in horticulture and poultry-keeping, to residents in the borough. By arrangement, the instruction is undertaken by the county agricultural staff.

Merioneth.—A full-time instructress in dairying and poultry-keeping and an instructor in agriculture and rural science were appointed. The latter instructor devotes only a portion of his time to agricultural education work.

Monmouth.—A tender for the erection of the new hostel and educational buildings at the Usk Farm Institute at a cost of £22,202 was accepted. The hostel is designed to accommodate thirty students in addition to certain members of the staff.

Full-time instructors in horticulture and in poultry-keeping were added to the institute staff.

Pembroke.—A separate instructress in poultry-keeping was appointed, the instructress in the joint subjects of dairying and poultry-keeping thereafter to confine her activities to dairying.

II.—DAIRYING AND SMALL LIVE STOCK

Milk and Dairy Work.—Educational work in dairying conducted by local education authorities has been well maintained during the last few years, as the table below shows. In this case statistics are available for the year 1925-26, and are included for comparison.

COMPARATIVE STATEMENT OF INSTRUCTION IN DAIRYING PROVIDED BY LOCAL EDUCATION AUTHORITIES IN ENGLAND AND WALES DURING THE THREE YEARS ENDED MARCH 31, 1926

	1923-4	1924-5	1925-6
(1) Total No. of instructors and instructresses employed (including those employed temporarily during the season)	65	69	72
(2) Travelling Dairy Schools			
No. of teachers employed	32	39	38
No. of students who received instruction	2,611	2,585	2,728
No. of farms visited	874	817	1,106
(3) Number of farmers who participated in co-operative cheese-making schemes	49	18	42
(4) Farm Institute Courses			
No. of courses	41	37	46
No. of students who received instruction	482	462	487
(5) Lectures and Demonstrations			
(*a*) Clean Milk Production			
No.	360	544	667
Attendance (approx.) ..	9,500	12,600	17,000
(*b*) General Dairying			
No.	196	198	290
Attendance (approx.) ..	5,300	6,300	10,000

The most noteworthy features of this statement are the diminishing interest in the co-operative cheese school scheme and the increased attention that is being given to the question of clean milk production. On the former point it need only be said that so long as milk producers are satisfied with an arrangement under which the bulk of the surplus milk produced is manufactured by the distributors they are not likely to concern themselves seriously with the establishment of surplus milk depots by co-operative effort. Many authorities, however, including the Linlithgow Committee, take the view that the better scheme, not only for farmers but for all interested in the dairy industry, would be one in which the surplus was manufactured at the main centres of production by the farmers

themselves. The attention of the distributive trade would then be focussed on the supply of whole milk to the consumer; while the manufactured products, made from fresh untravelled milk, would be more acceptable to the consumer and therefore better able to compete with dominion and foreign competition. Farmers' organizations are of course aware of these arguments, and in certain counties, notably Sussex and Essex, co-operative movements for the manufacture of surplus milk have been set on foot. Local education authorities, by taking advantage of the Ministry's co-operative cheese school scheme, are in a position to assist such schemes by providing the preliminary education which is often required to test its commercial possibilities. The initiation, however, must come from the farmers themselves, and the Ministry can only say that in cases where producers are desirous of testing the possibilities of co-operative effort, but are not sufficiently confident to embark on a strictly commercial venture, sets of cheese manufacturing plant are available for loan, free of charge, provided that the local education authority is prepared to undertake the supervision of the scheme during the season. In such event the authority would provide the services of an instructress to give instruction to students and generally to safeguard the educational nature of the scheme, while the farmers would be responsible for guaranteeing a minimum daily quantity of milk, and for the appointment of a manager of the depot, and would undertake to accept payment for the milk on the basis of the returns from sale of produce.

The widespread interest which has developed in the question of clean milk production is the most encouraging feature of dairy educational work. The increased activities of county education staffs in the way of lectures, clean milk demonstrations, and so on, are sufficiently indicated by the figures in the statement above. The following table, referring to clean milk competitions, is also suggestive :—

	1923-4	1924-5
No. of competitions held	7	26
No. of competitors	181	563
No. of cows	4,662	15,467

The *Guide to the Conduct of Clean Milk Competitions* (Miscellaneous Publications, No. 43, price 4d.), issued by the Ministry in 1924 and since revised, has proved of great value as a means of securing uniformity and stimulating interest. The movement now covers almost all the important milk-

producing areas, and the aggregate effect on the milk supply is considerable. Broadly speaking, however, farmers are still left without the incentive of "a higher price for a cleaner product." In course of time this is bound to come, and the lead should properly be taken by the distributing trade. The latter, in turn, waits on public opinion ; hence the Ministry attaches the greatest importance, in this phase of educational work, to securing the co-operation of those who are able to influence public opinion, particularly public health committees and medical officers of health.

In other directions the Ministry has assisted local authorities and other bodies in their efforts to secure an improved milk supply ; for example, by the circulation of a scheme of milking competitions, drawn up by a committee of experts, and by the loan of clean milk demonstration apparatus for use at agricultural shows. In all this work close touch is maintained with the National Institute for Research in Dairying, Reading, whose efforts to stimulate a scientific interest in clean milk production are well known. The period under review also saw the initiation of a scheme under which dairy bacteriologists have been appointed at most provincial colleges to undertake the bacteriological tests of milk samples and to give assistance to county staffs in their advisory work on clean milk production. Reference should also be made here to the special courses in clean milk production which are now held at most of the agricultural colleges for the benefit of sanitary inspectors employed by local authorities. These courses represent a new feature of educational work, which is intended ultimately to secure that those concerned with the administration of measures of milk control should become acquainted at first hand with the practical aspect of milk production and hygiene. The courses were initiated by the Ministry after consultation with the Sanitary Inspectors' Association, and so far they have been well attended and much appreciated. They are distinct, of course, from the courses for county instructors, which have been held for some years at Reading, and from the courses for milk recorders held at Reading and the Midland College.

Finally, a word may be said on the question of the rationing of dairy cows, which provides one of the surest means of reducing the cost of milk production to the farmer. A good many local education authorities operate advisory rationing schemes, but there is, or was, considerable diversity of treatment, which militated against the value of the work. In

September, 1924, the Ministry set up a committee to consider and advise as to a uniform scheme of advice in rationing, the general adoption of which would enable a closer comparison to be made of results obtained on different farms and in the several counties. The committee's report, which was submitted in August of the following year, was printed and circulated to local education authorities and other bodies interested in the promotion of rationing advisory schemes. The main conclusion of the committee was that the general administration of a scheme of advice on rationing, uniform in its main principles, was both practical and desirable, and a standard scheme was outlined which provided, *inter alia*, for the utilization of milk-recording societies as extensively as possible. The committee also recommended that in milk-producing counties agricultural organizers should be provided with the assistance of one or more officers, specially appointed to deal with matters of dairy husbandry, with particular reference to rationing. Up to the moment no definite move has been made on the part of local education authorities to increase their staffs as recommended by the committee, but reports received by the Ministry indicate that interest in the scientific feeding of dairy cows is being much stimulated amongst dairy farmers, and also amongst those authorities whose educational activities have not so far included a rationing advisory scheme.

Small Live Stock.—Through its Poultry Advisory Committee, which includes representatives of all sides of the poultry industry, the Ministry is able to keep in close touch with the industry's needs, and to suggest from time to time educational schemes calculated to develop scientific knowledge amongst poultry-keepers. Although in the aggregate the industry is a large one, and makes a substantial contribution to the home-produced food supply, the working unit is usually small. The small-holder and cottager, with little capital and unaccustomed to think in terms of "big business," are often content to run a mixed flock of hens, accepting eggs gratefully when they come, worrying little when they do not, and rarely concerning themselves with the value of pure stock and the possibilities of securing a more regular production of eggs. The educational schemes of local authorities are directed largely towards raising the standard of poultry-keeping amongst this class, which forms an appreciable proportion of the whole industry, and presents one of the most hopeful

avenues to capturing for the home market some of the very considerable trade in imported eggs and table poultry.

The local education authorities of fifty-three counties have now appointed instructors (or instructresses) in poultry-keeping. Their work is mainly of an itinerant nature, lectures and demonstrations, given singly or in series, being followed by advisory visits to poultry-keepers in the area. Two schemes may be specially mentioned, *viz.*, egg-laying trials and the scheme for the distribution of hatching eggs and day-old chicks. The latter scheme has as its object the introduction of pure strains from trap-nested stock to the "small" poultry-keeper who could not otherwise afford to purchase satisfactory eggs or chicks. A certain number of "station-holders," subject to inspection by the authority, is selected by each county adopting the scheme; the eggs (or chicks) are distributed to approved applicants at reasonable rates, and the difference between these rates and those which would normally be obtained is made up by means of a small "subsidy" paid by the authority to the station-holder. The cost of the subsidy and other expenses arising out of the scheme are aided by the Ministry at the rate of 66⅔ per cent. The scheme is now in operation in forty counties (in four cases on a non-subsidy basis), and the following table shows the extent to which it is utilized :—

EGG-DISTRIBUTION SCHEME

Year			No. of station-holders	Total distribution	
				Eggs	Chicks
1922	..	..	208	91,034	35,991
1923	..	..	292	97,142	36,770
1924	..	..	316	107,960	49,007
1925	..	..	353	112,464	58,772

It need hardly be added that a careful watch is kept over the distribution of eggs and chicks under the scheme, and as far as possible their dispatch is followed up by advisory visits from the county poultry instructor in order that the value of securing high-quality stock may be properly appreciated and full advantage taken of it.

Egg-Laying Trials.—These have now been organized in some thirteen counties. Apart from their value in stimulating the production and maintenance of high egg-producing stock they afford a unique means of demonstrating the chief points in up-to-date poultry management, and in this way possess educational merits which the Ministry would commend to all local education authorities. The trials are financially self-

supporting, the Ministry aiding only the salary of the manager in charge and the initial outlay on establishing the trials. In 1924 the Poultry Advisory Committee drew up a set of model regulations and a uniform method of scoring, and with few exceptions these have been adopted by the authorities who are conducting laying trials.

Stud Goat Scheme.—This is administered by the British Goat Society, with the aid of a grant from the Development Fund. Approved stud goats, of a standard not lower than that required for entry into the Society's herd book, are selected throughout the country, on an undertaking by the owners to provide services at low fees (not higher than 5s.) for small-holders and cottagers. A subsidy is paid by the Society in respect of these services, the cost being refunded by the Ministry. The scheme thus aims at raising the standard of milch goats kept by "small men," and increasing the value of goat-keeping as a source of milk in the remoter districts. Particulars of the progress of the scheme are as follows :—

Year	No. of centres	Stud-goats approved	Services given
1924-5	73	73	841
1925-6	83	89	1,115

National Poultry Institute Scheme.—A full description of the objects of this scheme and the method of administration was given in the above-mentioned report of the Intelligence Department (pp. 106-110). The progress of the research work which is being conducted under the scheme is also fully described elsewhere.* It will be sufficient to say here, therefore, that the later stages of the scheme, *viz.*, the completion of the poultry investigation plant at the National Institute of Poultry Husbandry at Harper Adams Agricultural College, and the equipment of that centre as an institution fully qualified to undertake higher education in small livestock husbandry, have reached an advanced stage of progress. Up to March 31, 1926, capital expenditure amounting to £20,824 had been incurred on the whole scheme, which by completion is expected to cost £26,000, towards which the poultry industry contributes one-fourth. Maintenance grants in respect of the various portions of the scheme commenced to be paid in 1922-23 and have now reached £6,500 per annum, which is approximately the annual expenditure estimated to be involved in the full working of the scheme.

* *Research and the Land.* By V. E. Wilkins, B.Sc. (London : H.M. Stationery Office, 2s. 6d. net, cloth 3s. 6d.)

III.—SCHOLARSHIP AND TRAINING SCHEMES

Scholarships for the Sons and Daughters of Agricultural Workmen and Others.—This scheme was introduced under Section 3 of the Corn Production Acts (Repeal) Act, 1921. which specified scholarships as one of the subjects of aid from the fund of £1,000,000 provided for agricultural development. The five-year period to be covered by this fund expires on March 31, 1927 ; thus the 1926 awards comprised the last of the scholarships to be granted under the Act, and it has not yet been decided whether the scheme shall be continued as a permanent feature of the Ministry's educational activities. During the "experimental" period the scheme has been administered by the Central Scholarships Committee of the Ministry, the award of Class III scholarships (short-course) being made after considering recommendations made by area scholarships committees, composed mainly of representatives of local education authorities and of agricultural labour organizations. The total cost of the scheme during this period, including the completion of scholarships awarded this year, will be approximately £108,000.

The following statement sums up the position regarding applications and awards for the five years :—

	1922	1923	1924	1925	1926	Total
Eligible applicants ..	162	206	289	303	304	1.264
Scholarships awarded						
Class I	7	8	14	9	11	49
Class II .. .	10	11	14	10	10	55
Class III . ..	73	89	124	109	113	508
Total ..	90	108	152	128	134	612
Occupations of parents						
Agricultural workmen..	21	21	38	23	42	145
Working bailiffs ..	4	6	11	11	6	38
Small-holders	19	25	37	40	39	160
Other rural occupations	21	23	26	25	22	117
Candidates who were themselves agricultural workers	25	33	40	29	25	152

A full report of the working of the scheme will be published in due course. In the meantime it may be said that, educationally, the scholars have, with extremely few exceptions, justified their selection by securing satisfactory diploma and

certificate awards at the conclusion of their courses of training. There is little doubt, also, that the scholarships have had a marked influence on the careers of the recipients. It is not possible to give here the details of the numerous cases of progress which have been brought to the Ministry's notice, but it may be said generally that in the case of the large majority of the scholarships which have already terminated, the students have succeeded in securing satisfactory posts in agriculture or horticulture, or have used the scholarships as a stepping-stone to a more prolonged period of training.

Post-graduate Scholarships for Intending Agricultural Organizers and Teachers.—The Ministry, in conjunction with the Board of Agriculture for Scotland, awards a limited number of scholarships each year to provide further training for graduates who contemplate a teaching or advisory career in agriculture. The scholarships are awarded on the recommendation of the Advisory Committee on Agricultural Science; they are tenable for two years, of which the first is normally spent at a research institute in this country, and the second at a university abroad. The main object is to give the scholars a broader view of the agricultural industry as a whole, and thus to introduce by degrees a more enlightened vision into the teaching of agriculture in this country. The scheme was commenced in 1924, and the following scholarships have been awarded to applicants from England and Wales:—1924, 4; 1925, 4; 1926, 3. The foreign universities visited have been California, Cornell, Minnesota, and Wisconsin. The scholarships include in all cases a course in the technique of teaching.

Training of Disabled Officers in Agriculture under the Royal Pensions Warrant.—Of the four schemes administered by the Ministry since the Armistice for the training of ex-officers and men in agriculture, the above is the only one still in being, and that to only a limited extent. Twelve ex-officers were accepted for training during 1924, and the majority of these were placed on farms in this country approved for the purpose by county authorities for agricultural education. The remainder were accommodated on farms overseas, all necessary arrangements for their training being made through the Dominion and Colonial Governments concerned, and, in the case of one ex-officer who proceeded to a foreign country, through the British Consul. Whilst undergoing training—the maximum duration of which was two years—each

officer received from the Ministry as a training allowance the difference between his disability retired pay and the maximum disability retired pay for his rank. The progress of the scheme up to March 31, 1925, is indicated in the following table :—

	England and Wales	Overseas	Total
In training	21	4	25
Completed or left training	430	81	511
Total approved .. .	451	85	536
Rejected	11	1	12
Applications withdrawn	83	12	95
	545	98	643

TRIALS OF CAULIFLOWERS FOR PICKLING

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THE trials, summarized in the following notes, were conducted in 1925 with the object of finding out the most suitable varieties of cauliflower for pickling purposes ; and they were started because inquiries had shown that over four-fifths of all the cauliflowers used here in pickles were imported from abroad, the manufacturers stating that they are unable to obtain from English growers the type of cauliflower they want, although they offer good prices.

The cauliflower required for pickling should have a close, compact and firm, white head, with but little stalk. The "curd" or "flower" is the valuable part ; stalk is waste and must be cut out, so far as the best-grade pickles are concerned. The greater the proportion of curd and the smaller the proportion of stalk, the more suitable is the head for the purpose. A loose, stalky, and "seedy" yellowish head is useless. There are intermediate types, but the accompanying illustrations of (A) a good type and (B) a bad type of head demonstrate, respectively, what is and what is not suitable for the pickle maker.

Arrangement of the Trials.—A comprehensive selection of cauliflowers was made for the test. Some were varieties grown only on the Continent ; others, though favoured there, are not well known here ; while a third category comprised all the

better-known and most popular varieties grown in this country. The list was further extended by including, in most cases, different stocks of each variety, to ascertain the comparative value of strains. All the cauliflowers were grown under ordinary field conditions.

The seed was sown in early May on a carefully-prepared seed-bed, and the plants were transplanted in early July into well-prepared ground, following a celery crop which had failed through drought. At this time the plants were getting rather "leggy," and it would seem advisable to regulate time of sowing to suit the time when transplanting is likely, for leggy, overgrown plants do not make a good beginning for the crop. This point is worth some attention, as where cauliflowers are grown as a field crop, they usually follow early potatoes, or they may follow spring cabbage, and transplanting time depends absolutely on the time of removal of the first crop. Definite information on this matter is not available at the moment but, in the writer's opinion, it is desirable to exercise judgment, and not necessarily to sow at a certain time, just because it is the customary time.

The land had been well worked for the previous celery crop, and had received a dressing of farmyard manure. At the time of planting out the cauliflowers, a dressing of 1½ cwt. sulphate of ammonia, 4 cwt. superphosphate, and 1½ cwt. muriate of potash, per acre, was mixed and worked in to the soil just before planting. After-cultivation consisted of several hoeings to keep the land open and loose, and free from weeds; good cultivation throughout is necessary for this crop.

The trials suffered through very dry weather after the seed was sown and at transplanting time, and, as a result, many of the stocks were finally represented by but few plants. This affected judgment chiefly in regard to general habit of growth and the possible yield of certain stocks, and it also prevented a really full comparison of strain; but the main object, of determining the suitability of varieties for pickling, was not interfered with, and upon this point very definite information was obtained.

As the stocks came into full cropping, heads of each variety were examined and judged from the standpoint of their suitability for pickling; the results are given in the accompanying table. A selection of heads was also submitted to a prominent firm of pickle manufacturers, and their observations on the merits of the respective specimens are given in the last column of the table.

Type A.—"Danish Giant" Suitable

Type B.—"All the Year Round." Unsuitable

Trials of Cauliflowers for Pickling.

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Observations on the Trials.—A study of the table shows that several varieties stand far ahead of the others in suitability for pickling purposes. Danish Giant, Erfurt Dwarf, Erfurt Forcing, Erfurt Mammoth and Delft Short Stem are all good; of these, Danish Giant must be awarded pride of place in these trials. The firm of pickle manufacturers, to whom heads were submitted, declared it equal to the best cauliflowers imported from Italy.

The varieties commonly grown in this country, such as Veitch's Autumn Giant and Eclipse, are not really suitable for pickling, although, by careful selection, a fair sample of Eclipse could be made up.

The table reveals remarkable differences, in general habit and in time of cropping, between different strains of some of the varieties; and, in some cases, two distinct types were noticed and described in the one stock, *i.e.*, Early London, Stock C., Walcheren, Stock A., and Early Erfurt Mammoth. This question of variation in strain opens up a big issue. As a result of these trials certain varieties are shown to be good for pickling purposes; the question is whether the grower can be sure of getting similar results to those of the trials no matter where he purchases his stocks of the suitable varieties. Information on this point is not complete because, as already stated, many stocks were represented by only a few plants, and further investigation is proceeding. All that can be said now is that caution is necessary in selecting the strain of any particular variety decided upon. It may be noticed, for instance, that stock "A" of Danish Giant stood well ahead in the trials of stock "B."

It should be pointed out that for practical purposes, so far as the object of the trials was concerned, the bulk of the varieties cropped very close together. One stock of Early London cropped weeks before any other stock in the trials, while both stocks of Giant Italian were very late. Early London is, however, an early variety and frequently used in this country for forcing purposes.

Some Notes on the More Successful Varieties.—A little information about the better pickling cauliflowers, as shown by these trials, may be of interest. All are varieties but little known in this country. They cropped about the same time as the bulk of the other varieties; if anything they were a trifle later than the average. They were all either of smallish or medium growth. Danish Giant, the best of them all, was on

NOTES ON TRIALS OF CAULIFLOWERS FOR PICKLING—WITH PICKLE MANUFACTURERS' OBSERVATIONS ON SPECIMENS SUBMITTED

Variety of stock		Notes on habit of stock	Position on September 24, 1925, as regards cropping	Notes on the head	Suitability for pickling	Pickle manufacturers' opinion
Danish Giant ..	A	Smallish to medium growth Upright habit, tending to open out Ordinary green colour	Beginning to crop	Small size White, firm, close.	Good .	The best flower, similar to best imported Italian.
	B	Smallish, medium growth Open habit, sometimes bushy. Ordinary green, perhaps a little light.	Only just beginning to crop.	Slightly yellow colour. Medium size. Firm. Type varies a little: small size (a) white and firm. Larger (b) often rather loose and yellowish in colour	(a) Good. (b) Only fair	Very nice flower, rather long in stalk.
	C	Smallish to medium growth Fairly upright habit, with a strong tendency to open out. Ordinary green colour, perhaps a trifle light.	Not yet cropping ..	Medium size White, firm, compact, short stems	Good ..	—
	D	Good medium growth. Open and bushy habit Dark green colour	Not cropping. A very thin plot.	Medium to good size. White. Firm, sometimes inclined to be a little stemmy.	A good medium type	—

Erfurt Dwarf ..	–	Smallish medium to medium growth. Fairly upright, though open habit. Ordinary green, occasionally somewhat dark.	Cropping. Good many bolters.	White. Medium to good size. Type varies: medium size (*a*) compact, close, short stems; (*b*) comparatively loose, longer stems.	(*a*) Good .. (*b*) Not suitable.	Very nice flower. but too thick in stalk.
Erfurt Forcing..	–	Smallish medium to medium growth. Sits close to ground, tends to spread out. Colour ordinary green, perhaps a trifle light.	Cropping	White. Medium to large. Firm.	Good. One of the best.	Very nice flower. Colour not so good as above.
Erfurt Mammoth	–	Medium growth. Upright and close habit. Ordinary green colour.	Cropping	White. Large medium large size. Firm.	Good. Approaching best.	Nice flowers, but not equal to Danish Giant A. and B., Erfurt Dwarf and Erfurt Forcing.
Early Erfurt Mammoth.	–	Majority type: growth tallish and strong. Open habit. Ordinary green colour. Minority type. Smallish, medium growth. Fairly upright habit. Ordinary green colour.	Not yet cropping .. Just beginning to crop.	Both types: Medium size, rather small. Slightly yellow, close compact, short stemmed.	Good type; on small side.	Same as for Erfurt Mammoth.
Early Erfurt Dwarf Mammoth.	–	Good medium growth. Upright, close habit. Ordinary green colour, perhaps somewhat light.	Just beginning to crop.	White. Small medium size. Compact.	Good.	—

Variety of stock		Notes on habit of stock	Position on September 24, 1925, as regards cropping	Notes on the head	Suitability for pickling	Pickle manufacturers' opinion
Early London ..	A	Smallish type, tending to spread. Rather light green in colour.	Ran badly and early. Finished at this date.	Medium size. White in colour. Firm.	Varies from good to fair, but ran so badly as to be of questionable value for practical purposes. Probably planted too late for this variety.	—
	B	Smallish to medium growth; rather bushy habit: ordinary green colour.	Beginning to crop ..	Very small, white, compact, short stems.	Good, but not big enough.	—
	C	Two types. Majority type: good medium to tallish growth. Dark bluish green colour; pretty, upright habit. Minority type · medium growth; upright close habit; ordinary green colour.	Both types just beginning to crop.	White. Nice medium size. Very firm.	Varies from good to medium.	Same as for Erfurt Mammoth and Early Erfurt Mammoth.

Delft Short Stem	–	Medium growth. Fairly upright, with a tendency to open out. Ordinary green colour.	Beginning to crop ..	Good medium size. White, close, compact, short stems. Grows to a good size, but loses colour as it does so.	Very good.	Small, nice close flower.
Algiers	A	Tallish, semi-close habit. Dark bluish-green colour. A few plants of good, medium growth, tend to spread, and of ordinary green colour.	Cropping	White colour. Medium to large size. Nicely firm but stemmy.	Not suitable.	Poor quality, stalky and seedy.
	B	Tallish to tall growth, semi-close, upright habit. Dark bluish-green colour.	Beginning to crop ..	Dirty white. Rather loose. Medium size Stemmy.	Not suitable.	—
	C	Tallish growth. Somewhat open habit. A bluish-green colour, but not so dark as other stocks of this variety.	Pretty well finished cropping.	Smallish to medium size Slight yellowish colour. Too much stem. Open and loose.	Not suitable. One of the worst.	—
Eclipse	A	Tall growth. Good deal of leg. Upright, fairly close habit. Dark bluish-green colour.	Just beginning to crop.	Medium to fairly large. White colour. Rather open and stemmy. Firm.	Of medium suitability if not too large.	Fair quality, but seedy.
	B	A good, medium growth. Leggy. Upright, but tending to be open in habit. Dark bluish-green colour.	Cropping getting well forward.	Fair size. Rather yellowish in colour; short stems; rather open and not very firm.	Not very suitable.	—

Variety of stock		Notes on habit of stock	Position on September 24, 1925, as regards cropping	Notes on the head	Suitability for pickling	Pickle manufacturers' opinion
Eclipse	C	Medium to tallish growth. Leggy. Upright, close habit. Dark bluish-green colour.	Cropping	Varying from small medium to large size. Slightly yellowish in colour; smaller heads are better in colour and firmer than larger ones.	Medium suitability. Small heads better than large ones.	—
All the Year Round.	A	Small growth. Open, bushy habit. Dark green colour.	—	A very thin stock; no further information was obtained.	—	—
	B	Smallish; open and bushy habit. Dark green colour.	Cropping nearly finished.	Large. Slight yellowish colour. Rather too open; longish stems.	Not suitable.	—
	C	Nice medium growth, some plants tallish. Open bushy habit. Dark green colour.	Cropping	White; medium size. Fairly firm; fairly short stems.	Fair ..	A good medium quality.
Veitch's Autumn Giant.	A	Tall. Upright and close habit. Dark bluish-green colour.	Cropping	White, with a slight yellowish tinge. Large medium to large size. Type varies a little. One type (*a*) is loose and stemmy, the other (*b*) firm, fairly compact and close-growing. Only small number of this (*b*) type.	(*a*) Not suitable. (*b*) Fair.	Very long, thick stalk and of no use.

Veitch's Autumn Giant.	B	Tallish to upright, but tending to open. Dark bluish-green colour.	Cropping	Slightly yellow in colour. Varies in size from small to large. Loose and stemmy.	Not suitable.	—
Early Snowball	–	Smallish growth, spreading habit. Dark green colour.	Early	Large, slightly yellow in colour. Firm, compact; short stems Type varies a little; some heads are of medium size and rather open.	Fair ..	Nice heads, rather stalky, but will cut up all right.
Giant Italian ..	A	Good medium growth. Fairly upright habit. Dark bluish-green colour.	Not yet cropping. Proved very late.	Owing to the lateness in cropping no further information was obtained.	—	—
	B	Fair to good medium growth. Some fairly upright in habit, but most plants tend to spread. The first type is distinct from the second. Dark bluish-green colour.	Late.. .. .	Smallish to medium size. White, close, compact heads; short stems and trifle open.	Fairly good; a little too open.	—
Early Paris ..	A	Good medium to tallish growth. Habit open, tending to spread. Dark green colour.	Cropping .. .	Medium to large size. Slightly yellowish colour. Stemmy and often loose.	Not suitable.	—
	B	Tallish, upright but open habit, with a tendency to spread. Dark green colour.	Not yet cropping ..	No further information obtained.	—	—

Variety of stock		Notes on habit of stock	Position on September 24, 1925, as regards cropping	Notes on the head	Suitability for pickling	Pickle manufacturers' opinion
Walcheren ..	A	Two types. Majority type medium growth, sits well to ground, upright habit: ordinary dark green colour. Minority type tall growth, upright habit; very dark bluish-green colour.	Both types cropping.	Both types good size, but loose and stemmy. White.	Not suitable.	—
	B	Medium growth, bushy habit, sitting well to ground. Dark bluish-green colour.	Cropping	Good medium size. Slightly yellowish colour. Stemmy, loose.	Not suitable.	—
	C	Medium growth, upright but tending to spread. Dark bluish-green colour.	Just beginning to crop.	Medium size. Trifle yellowish in colour. Inclined to be loose and stemmy.	Not suitable.	—
Lecref Self-Protecting.	–	Medium growth. Open, spreading bushy habit. Sits to ground. Leaves tend to curl a little. Dark green colour with bluish tinge.	Cropping	Medium size. Firm. Slightly yellow.	Medium type.	—
Enkhuizen ..	–	Good medium size. Open bushy habit. Dark bluish green colour.	Cropping	Slightly yellow in colour. Medium to large size. Fairly firm.	Fair ..	—

the small side. The heads produced were also small, as a rule. If they grew big, they began to lose quality, although it must be noted that Erfurt Mammoth and Erfurt Forcing produced good-sized heads of very suitable type. On this point further investigation is being carried on. Again, all the more successful varieties were of high-grade quality for ordinary culinary purposes. Indeed, in the writer's opinion they were better in this respect than many of the kinds commonly grown, the large proportion of curd and small proportion of stem making a more delicate cauliflower for the table.

As the varieties which did best in these trials are usually of smallish habit and, as a rule, produce smallish heads, especially Danish Giant, they might well be planted closer together in the row, and, if practicable for working, the rows, also, might be less distance apart. For the time being, 1 ft. 6 in. between the plants by 1 ft. 6 in. or 1 ft. 9 in. between the rows would appear to be a useful distance for planting; and this point is being further investigated. In connexion with this question, it may be pointed out that, planted at the ordinary distance of 2 ft. by 2 ft., an acre will carry 10,890 plants. With the type of cauliflowers ordinarily grown for market, weighing about 1¼ lb each, this would mean a production of 13,612 lb. of cauliflower per acre. On the other hand, Danish Giant, weighing ¾ lb. per head, grown on the same basis, would produce 8,167 lb. of cauliflower. Weights are taken as of heads free of foliage in both cases

If planted 1 ft. 6 in. by 1 ft. 6 in., however, Danish Giant would produce 19,360 plants per acre, equivalent to 14,520 lb. of cauliflower, thus giving the same yield per acre as the larger kinds; and, if sold on the ordinary market, the increased number of plants per acre would probably weigh against a possible reduction in price, due, despite the better quality, to lack of size.

Conclusion.—It may be observed that the pickling trade seems to offer a promising opening for home-grown cauliflowers of the right type, offering the grower an alternative market, which is eminently desirable when he has so little control over the sale price of his produce. Good prices are offered by the pickling trade, prices far ahead of anything realised on the ordinary market during the 1925 season. It must be remembered, however, that cauliflowers for pickling must meet the requirements of the manufacturer. He must

be offered the right class of article, and in the form in which he can best deal with it; otherwise he will continue to buy from the foreigner, who in this, as in many other ways, is ever ready to frame his production to suit the demands of the British customer.

As already intimated, the trials, further elaborated, have been continued during the current year. In these 1926 trials, closer planting of Danish Giant is being tried for comparison in weight of crop against Veitch's Autumn Giant.

Preliminary Note on the Results of the 1926 Trials.—The 1926 trials, now nearly completed, confirm last season's results, so far as varieties are concerned, and further reveal the necessity for careful selection of stock of whatever variety is grown. A block of Danish Giant grown for pickling was reported on by the manufacturers as really very good, and contract prices were asked for. In contrast to this, and emphasizing the necessity of exercising care in choice of stock, a grower reports that he has grown a certain stock of Danish Giant and his manufacturer is full of complaints.

The seed was sown at the end of April, a trifle earlier than last year; transplanting commenced on June 24, the crop following spring cabbage. At this time the plants were of nice growth for the purpose. Manuring was exactly as for the 1925 trials, a dressing of farmyard manure being ploughed in after the cabbage had been cleared. A definite point arising from these trials is that the land for those varieties suitable for pickling must be well prepared, although they do not require more than ordinary cultivation. The common varieties, such as Veitch's Autumn Giant, Eclipse, etc., will stand a little rough treatment, but not so Danish Giant, the Erfurts, and so on. It can now be stated definitely that Danish Giant and other such varieties may be planted, with advantage, close in the rows, as near as 1 ft. in the rows by 1 ft. 6 in. between the rows, or any such distance as is most convenient for after cultivation.

AGRICULTURAL MACHINERY TESTING SCHEME

REFERENCE has been made from time to time* to the scheme for testing agricultural machinery which has been instituted in order to furnish accurate information for the guidance of farmers and manufacturers regarding the utility, efficiency, reliability and working costs of each machine or implement tested. A number of tests are proceeding as a result of applications from manufacturers.

The result of the first completed test (on a 6-h p. oil engine manufactured by Messrs. Fairbanks, Morse and Co.) is printed below. It will be seen that it consists of two documents, a certificate under the seal of the Ministry and a report by the Agricultural Machinery Testing Committee.† The certificate states the bare facts of the test. The report goes beyond these bare facts ; it contains information on the mechanical construction and condition of the engine on stripping, on the running costs, and an expression of opinion as to the merits of the design.

From the information supplied in these documents a prospective purchaser should be able to form a reliable opinion on the merits of the article. The first report and certificate may, however, be of interest to a wider circle of readers. The documents here printed may be taken as fairly representative of what will be produced as the result of tests of other machines. The amount of detailed information will obviously vary : in the case of complicated machinery it may be extensive ; with simple implements subjected to simple tests the certificate and report will be short.

MINISTRY OF AGRICULTURE AND FISHERIES

CERTIFICATE OF PERFORMANCE UNDER TEST of 6-h.p. Fairbanks-Morse Internal Combustion Engine, manufactured by Messrs. Fairbanks, Morse and Co., Ltd., Chicago, U.S.A., and entered for test by Messrs. Fairbanks, Morse and Co., 87 Southwark Street, London, S.E. 1.

The engine was tested by the Institute of Agricultural Engineering, University of Oxford, acting under the authority of the Minister of Agriculture and Fisheries.

* See this JOURNAL for May, 1925, page 184 ; August, 1925, page 387 ; and November, 1925, page 675.

† The Committee consists of Mr. C. Dampier Whetham, F.R.S. (Chairman); Mr. H. German; Mr. J. H. Hyde, of the National Physical Laboratory; Mr. L. A. Legros, O.B.E., M.I.M.E.; and Dr. B. J. Owen, Director of the Institute of Agricultural Engineering, Oxford.

The following data were obtained as a result of this test:—

BRIEF SPECIFICATION

Single cylinder, horizontal trunk type with detachable cylinder head, horizontal split bearings. Automatic inlet valve, exhaust valve operated by half-time shaft through spur wheels. Sight feed lubricator supplying cylinder and pistons, grease cups supplying big end to connecting rod, main bearings, spur wheels, governor and magneto gear. Throttling governor system. Rotary high-tension magneto. Requires petrol for starting, then runs on paraffin. Speed 450 r.p.m. Cylinder bore, 5¾ in. Stroke, 8 in. Diameter of shaft, 2 $\frac{3}{16}$ in. Normal rating, 6 b.h.p. Price £43.

DETAILS OF RESULTS

(1) Duration of Trials

	Hours		Observations
	Preliminary run	Test run	
No load ..	10	4	Close speed regulator in us
Full load ..	5	9	
Over load ..	2	5	Governor position altered
Belt test ..	1	5	

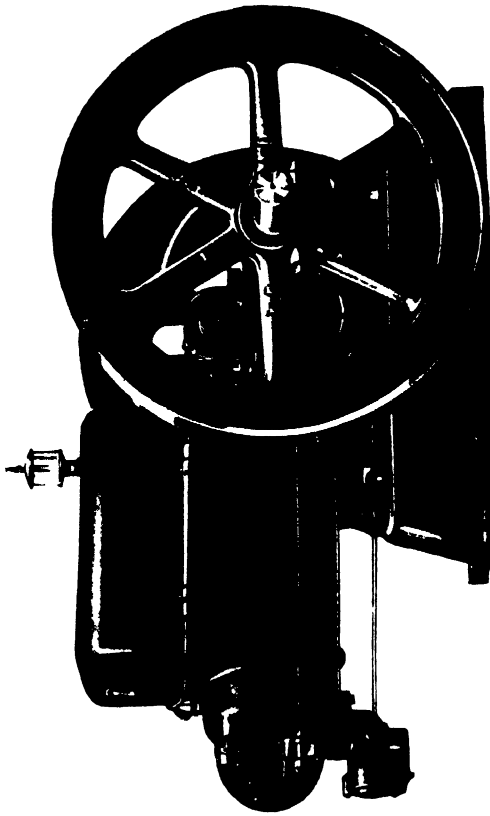
(2) Brake Horse-Power and Fuel and Oil Consumption

Brake horse-power	Fuel consumption in pints	Number of hours running	Fuel per brake horse-power hour in pints	Fuel per hour in pints	Lubricating oil consumption in pints
Nil	8·13	4		2·03	0·30
2·48	12·00	5	0·99	2 40	0·45
3·26	19·40	6	1·00	3 23	0·50
4·06	31·25	8	0·89	3·92	0·66
6·04	45·10	9	0·84	5·01	0·72
7·16	32·30	5	0·91	6·46	0·50

It is estimated that the fuel and oil consumption figures are correct within plus or minus one per cent.

GENERAL OBSERVATIONS

The engine continuously developed its rated power (6 brake horse-power) at the normal speed (450 revolutions per minute) specified. With a temporary alteration to the governor setting, the maximum power developed by the engine was 7 brake horse-power. The bearings and all moving parts ran satisfactorily under normal working conditions without overheating.



Fairbanks-Morse 6 h.p. Internal Combustion Engine, Type Z

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Loads were coupled to the engine directly by means of a brake and indirectly by means of a belt and, at 6 brake horse-power the fuel consumption averaged 5·01 pints per hour and oil consumption averaged 0·083 pint per hour.

L. S

IN WITNESS whereof the Official Seal of the Minister of Agriculture and Fisheries is hereunto affixed this twenty-third day of September, One thousand nine hundred and twenty-six.

(Signed) H. G. RICHARDSON,
Authorised by the Minister.

MINISTRY OF AGRICULTURE AND FISHERIES

MACHINERY TESTING COMMITTEE

REPORT ON PERFORMANCE UNDER TEST of 6 h.p. Fairbanks-Morse Internal Combustion Engine manufactured by Messrs. Fairbanks, Morse and Co., Ltd., Chicago, U.S.A., and entered for test by Messrs. Fairbanks, Morse and Co., 87 Southwark Street, London, S.E. 1.

CLASS.—Internal combustion engine.

NAME.—Fairbanks-Morse 6 h.p. Stationary Engine.

DETAILS

Description.—Single cylinder horizontal trunk with removable cylinder head. Hopper cooled. Automatic inlet valve. Exhaust valve operated by half-time shaft through spur wheels.

(1) *Lubrication.*—Sight feed drip lubricator supplying cylinder and piston, grease cups supplying connecting rod, main bearings, spur wheels and governor arrangements.

(2) *Governing System.*—A system employing the throttling principle operating through rotating weights on to a butterfly valve on the carburettor. Close speed hand regulator fitted.

(3) *Ignition.*—Ignition is supplied by a Fairbanks-Morse rotary high-tension magneto. The magneto is sealed.

BRIEF SPECIFICATION

Speed	450 revolutions per minute.
Cylinder bore	$5\frac{3}{4}$ in.
Stroke	8 in.
Diameter of shaft ..	$2\frac{5}{16}$ in.
Size of belt pulley ..	12 in. × 6 in.
Size of flywheel	28 in. × $2\frac{1}{2}$ in.
Capacity of fuel tank ..	5 gallons.
Weight	760 lb.
Price (January, 1926) ..	£43.

SCHEME OF TEST.—The engine was bolted to timber baulks, which were in turn secured to the floor by long bolts set in concrete.

A series of tests was carried out from no load up to full load, and measurements were taken of brake horse-power, fuel and oil consumption. The load was applied by means of a Walker fan brake. Owing to the short length of the engine shaft it was not possible to couple the fan brake directly and an extension shaft was necessary. A flange coupling was bolted to the shaft and carried the extension shaft, which was supported by a Skefko plummer block mounted on a bracket secured to timber baulks, which were in turn bolted to the floor.

The brake consists of two rectangular plates held by radial arms in such a manner that they are presented normally to the direction of motion. The brake is calibrated.

The fuel is drawn into the carburettor by suction from a fuel tank located in the base of the engine. The tank was filled with a known weight of paraffin, and at the conclusion of each test was drained and the quantity removed was weighed and the quantity consumed ascertained. Similarly the quantity of cylinder oil consumed was measured.

Before tests commenced the engine was stripped and after re-assembly was run for about six hours to free all bearings..

SUMMARY OF RESULTS

(1) *Duration of Test.*—The number of hours running under test was 42 and the total hours of running 60.

(2) *Power Developed.*—Tests were made with the brake absorbing :—

(1) 2·48 h.p. (2) 3·26 h.p. (3) 4·06 h.p. (4) 6·04 h.p.

The engine developed a maximum horse-power of 7, with an alteration of the governor setting. The guaranteed power of the engine, 6 h.p., was continuously developed at the rated speed without overheating.

All bearings and moving parts ran satisfactorily under full load without overheating. There is a reserve of power beyond the rated h.p. of 6 as shown by the overload test yielding 7 h.p.

(3) *Fuel Consumption.*—The carburettor is provided with a small reservoir for petrol controlled by a valve for starting purposes. When sufficiently hot the engine runs on paraffin and except when running at full load one charge of petrol is sufficient to raise the temperature of the cylinder to that required for complete vaporisation of the paraffin. On full load and especially when the air temp ratue is low a second charge is usually required.

The consumption at various loads was as follows :—

Brake horse-power	Paraffin in pints per hour
Nil	2·03
2·48	2·40
3·26	3·23
4·06	3·92
6·04	5·01
Overload	
7·16	6·46

The paraffin used for running was Shell Brand, specific gravity 0·805, price 10d. per gallon. Calorific value, 18,500 b.th.u. per lb.

The petrol used was Shell No. 1 The capacity of the reservoir is just under half-pint. The lubricating oil used for the sight drip feed for the cylinder and piston was Speedwell b. sp gr. 0·9. The consumption works out at about one pint for every 12 hours of running at the rated horse-power, the average rate being 10 drops per minute.

The main bearings, connecting rod, spur wheels, and governor gear were lubricated by means of grease cups using Mobiloil grease.

MECHANICAL PARTS

CONDITION OF ENGINE ON STRIPPING

(*a*) *Piston and Cylinder.*—The piston showed very slight carboni a-tion on the head, but otherwise was in good condition. The rings were a good fit and in good condition. Lubrication was satisfactory.

The cylinder head gasket was not quite a good fit over the bolts, but there were no signs of leakage. The cylinder seemed not to have been ground satisfactorily, as tool marks running circumferentially were observed.

(*b*) *Valves.*—The valve seatings were in good condition. The valves operate through holes in the cylinder head casting, which are capable of being rebored and fitted with bushes should undue wear occur.

The exhaust valve is operated by a half-time shaft through spur wheels and the action of the inlet valve is automatic.

The spring on the inlet valve with this system must necessarily be weak and so does not provide the rapid closing necessary to prevent a small amount of spray being ejected through the air valve of the carburettor.

(*c*) *Ignition.*—Ignition is supplied by the Fairbanks-Morse rotary high- ension magneto. An impulse coupling on the magneto automatically operates at very slow speeds, retarding the spark, and cuts out after the first few revolutions. This materially aids starting.

(*d*) *The Carburettor* has two compartments, one for petrol, the supply being controlled by a needle valve. In the other compartment are situated the air valve, the delivery end of the piping from the fuel tank and a needle valve for the control of the paraffin supply. A butterfly valve automatically operated by the governor is also incorporated.

( ) *Bearings.*— The crankshaft bearing caps were removed and showed no signs of wear; lubrication was quite satisfactory. The big end bearings were in good condition, lubrication being satisfactory.

(*f*) *Durability and Upkeep.*—The engine is soundly constructed throughout and should stand up well to the work required of it. The engine starts easily, and during running only requires the cooling water supply to be maintained. With ordinary care the engine should have a long life.

(*g*) *Accessibility for Repairs.*—All parts are readily accessible for repairs and the farm mechanic should be able to carry out any replacements or adjustments should they be necessary. An instruction book, supplied with the engine, gives the fullest details of all the parts.

(*h*) *Adaptability for Machinery.*—Provision is made on both flywheels for attaching pulleys of two standard sizes. This arrangement is very useful as a pulley of one size may not be suitable for all the work the engine is called upon to do.

The pulley supplied was bolted on to the flywheel and a drive arranged on to a Bamford root cutter slicing beets The load fluctuates as the beets are gripped by the knives and this gives a series of slight shocks to the engine. The power required by the cutter on full load is in the region of 5 h.p., and the engine easily took the load.

( ) *Running Costs.*—On full load the cost of running the engine for one hour was as follows:—

Paraffin (at 10d. per gallon)	6·3d.
Lubricating oil (at 4s. 9d. per gallon)	0·5d.
Grease (at 10d. per lb.)	0·5d.
	7·3d. say $7\frac{1}{2}$d.

CONCLUSIONS

The engine continuously developed its rated power (6 brake horse-power) at the normal speed (450 revolutions per minute) specified. With a temporary alteration to the governor setting, the maximum power developed by the engine was 7 brake horse-power. The bearings and all moving parts ran satisfactorily under normal working conditions without overheating.

Loads were coupled to the engine directly by means of a brake and indirectly by means of a belt, and at 6 brake horse-power the fuel consumption averaged 5·01 pints per hour, and oil consumption averaged 0·083 pint per hour. Both these figures may be regarded as satisfactory.

Taking into consideration the class of work for which the engine is intended and the price, the design and structural arrangements are good. The design is such that all the main components are easily accessible.

DETAILS OF RESULTS

(1) Duration of Trials

	Hours		Observations
	Preliminary run	Test run	
No load ..	10	4	Close speed regulator in use
Full load ..	5	9	
Over load ..	2	5	Governor position altered
Belt test ..	1	5	

(2) Brake Horse-Power and Fuel and Oil Consumption

Brake horse-power	Fuel consumption in pints	Number of hours running	Fuel per brake horse-power hour in pints	Fuel per hour in pints	Lubricating oil consumption in pints
Nil	8·13	4	—	2·03	0·30
2·48	12·00	5	0·99	2·40	0·45
3·26	19·40	6	1·00	3·23	0·50
4·06	31·25	8	0·89	3·92	0·66
6·04	45·10	9	0·84	5·01	0·72
7·16	32·30	5	0·91	6·46	0·80

At 6 b.h.p. fuel consumption averaged 5·01 pints per hour, and oil consumption averaged 0·083 pint per hour.

It is estimated that the fuel and oil consumption figures are correct within plus or minus one per cent.

(Signed) C. DAMPIER WHETHAM (*Chairma*
P. BARKER (*Secretary*)
September 6, 1926. on behalf of the Committee.

METEOROLOGY AND AGRICULTURE

A SECOND conference arranged by the Ministry between workers engaged on the study of various aspects of the effect of weather on crop growth was held at the Meteorological Office on September 30 and October 1, 1926, under the chairmanship of Sir Napier Shaw, F.R.S. Those present included representatives from the research institutes at Rothamsted, Cambridge (Plant Breeding), Aberystwyth (Plant Breeding), Imperial College of Science (Plant Physiology), and Long Ashton (Fruit Growing), from the five crop-testing stations in England, and from several agricultural colleges and county agricultural staffs.

The following papers were read :—

The Influence of Summer Rainfall on the Fruiting of Apples (Mr. A. H. Lees, Long Ashton Research Station).

Meteorological Conditions and the Growth of Barley (Dr. F. G. Gregory, Plant Physiology Research Institute, Imperial College of Science).

Essentials of Theory and Points of Practice in Crop Weather Work (Mr. F. L. Engledow, Cambridge Plant Breeding Institute).

Technique of Crop Observations (Mr. T. Eden, Rothamsted Experimental Station).

Solar Radiation (Mr. R. Corless, Meteorological Office).

The Effect of Solar Radiation on Plant Growth (Prof. V. H. Blackman, Plant Physiology Research Institute, Imperial College of Science).

The Value of Co-ordination in Phenological Observations (Mr. J. E. Clark, Royal Meteorological Society).

The Value of Phenological Observations in Practical Agriculture (Mr. A. Roebuck, Midland Agricultural and Dairy College).

Space does not permit of a full account of these papers, but a brief summary of each is given below. It is proposed later to issue a full report of the conference, and a limited number of copies will be available for free distribution.

The Influence of Summer Rainfall on the Fruiting of Apples (*Mr. A. H. Lees*).—Flower buds of the apple, with their surrounding leaves, expand towards the end of May, and the weather following this period may be expected to influence their development. The leaves remain on the tree until the end of October or beginning of November, but conditions after the end of August appear to have but little influence. Attention was therefore focussed on the months of June, July, and August.

Although many meteorological factors may be expected to affect the plant, rainfall was selected partly as presenting a simple issue and partly because of the existence of suitable

data. Again, rainfall is probably the most important single factor, and it is a rough index of sunshine, soil moisture, and humidity.

Rainfall data were compounded from those for two Clifton stations and from the Long Ashton Research Station. For the purpose of comparison with fruit data these rainfall figures were classified into three groups : (1) *dry* (rainfall under 6 in. in the three months), (2) *medium* (rainfall between 6 in. and 9 in.), and (3) *wet* (rainfall over 9 in.). These figures correspond very closely to a resulting dry, moist, and very wet soil during these three months.

Descriptions of crop production were obtained from the Ministry for the general crop in Somerset, Devon, and Cornwall. Description of bloom was obtained from notes in the *Gardeners' Chronicle.*

On comparing the rainfall in the three months in question with the flower production in the following year it was found from pomological considerations that a further factor had to be taken into account, namely, that of previous crop.

As a result of the correlation of the various factors over the years 1906 to 1925 the following is put forward as a scheme for estimating the apple crop of any year given data for rainfall of the summer of the preceding year and the amount of the crop of the preceding year :—

Previous crop	*Previous rainfall*	*Succeeding crop*
Heavy	Wet	Very Poor
	Medium	Poor
	Dry	Medium
Medium	Wet	Poor
	Medium	Medium
	Dry	Good
Light	Wet	Medium
	Medium	Good
	Dry	Very good
None	Wet	Good
	Medium	Very good
	Dry	

This table only applies to adult trees over a large area, and cannot be applied to younger trees or those having special treatment unless those special conditions are duly allowed for. The table has been found to apply over a period of twenty years, provided always that excessive frost, or continuous cold winds do not interfere in spring.

Meteorological Conditions and the Growth of Barley (*Dr. F. G. Gregory*).—This investigation represents an attempt to simplify the complex problem of ascertaining the effect of weather on crops ; attention was confined to a single pure line of barley grown in pot culture from 1921 to 1924 at Rothamsted. The effect of variation in rainfall was largely

eliminated by controlled watering. During the investigation a large range of variation in climate was encountered : in 1921 the weather was remarkably fine and temperature high ; in 1922 a warm spring was followed by almost continuous dull and rainy weather ; in 1923 and 1924 a cold wet spring was followed by a warm and fine summer. In addition to standard meteorological observations of maximum and minimum temperatures and hours of bright sunshine, continuous records of temperature and sunshine were kept.

In collecting quantitative measurements of plant growth against which to measure the effect of weather conditions the aim was to select such measurements as would reflect the action of the chief physiological processes taking place. These roughly fall into two classes : (1) those concerned with nutrition and gross dry weight increase, and (2) those regulating development and structural changes. The first class is represented by the net assimilation rate, which measures the amount of dry matter produced per unit of time per unit area of the leaf surface. The second class of processes is represented by the relative leaf growth rate, which records the percentage increase in leaf area per week. The progress of the whole process of growth is expressed by the percentage increase in dry weight per week. The three measures of growth used were thus : (1) Net assimilation rate, (2) relative leaf growth rate, (3) Increase in dry weight per week, or efficiency index. These three quantities were calculated for weekly intervals up to the time of maximum leaf area. The conclusions drawn as regards each measure of growth are :—

(1) *Assimilation*.—The process of carbon assimilation is almost completely controlled by climatic factors, such other factors as manurial treatment being secondary in their effect. The highest correlation is with total radiation, higher light intensity leading to more rapid assimilation. Increased day temperature has an accelerating effect ; high night temperature has a retarding effect, partly due, no doubt, to losses of material by increased respiration at night.

(2) *Leaf Growth*.—The rate of leaf growth increases with increased day temperature and decreases with increased night temperature ; and it decreases with increased light intensity. This last finding indicates that, fter allowance has been made for high temperatures associated with bright sunshine, the effect of strong radiation is to inhibit leaf growth.

Leaf growth is hardly affected at all by variation in net assimilation rate ; this seems to indicate that under weather conditions such as prevail during early summer in this country net assimilation is maintained at such a level that the carbohydrate material formed is always in excess of the immediate needs of the plant for leaf growth material, and an excess must be laid down as reserve. It rarely happens, apparently, that

adverse weather conditions last long enough to exhaust these reserves for maintenance of leaf growth. Leaf growth is therefore relatively independent of external factors.

(3) *Efficiency Index.*—The dry weight increase increases with higher day temperature and decreases with higher night temperature; it is, however, almost independent of radiation, the effects of which on assimilation and leaf growth counterbalance one another. This means that the increase in dry weight proceeds at a normal rate whatever the conditions of illumination may be. This of course holds true only for the range actually investigated, *viz.*, average early summer conditions.

The facts emerging from this analysis are as follows: The two processes which determine the final amount of material accumulated by the plant, and hence to a large extent the yield, are: (1) the rate of development of the leaf surface, and (2) the efficiency of the leaf surface in building up carbohydrate.

The relative leaf growth rate determines the size of the effective area, and the net assimilation rate measures its efficiency. Bright sunshine has opposite effects on these two processes. A dull summer, other things being equal, will lead to a large leaf development, whose large size will tend to compensate for the low efficiency due to lack of light limiting the assimilation rate; conversely a bright summer will tend to reduce the size of the leaf surface, but this will be compensated for by high efficiency. In this way yield will tend to be maintained within narrower limits. Temperature has an accelerating influence on both processes; the range over which a plant may be successfully grown will therefore obviously depend on temperature relations. Perhaps this may explain the general relationship between the distribution of cereals and the run of the isotherms or zones of equal temperatures.

The facts determined enable us to visualize a clearer picture of the adaptation of plants to climatic conditions, and perhaps by closer studies of this kind the problem of adapting the variety to climate or the breeding of new varieties to suit the climate will become a practical possibility.

Essentials of Theory and Points of Practice in Crop Weather Work (*Mr. F. L. Engledow*).—The study of the effect of weather on crops represents an integration of almost all cropping problems, and is therefore a most complex and difficult task. The work involved is well worth while, however, if any definite relationships can be established: *e.g.*, the establishment of the relation between the weather and growth of the wheat plant in the first six weeks of its life would

represent a fundamental advance ; and, in fact, the connexion between any phase of weather and any phase of crop growth would be valuable.

In this work meteorologists have set the standards and the pace. Their work is done extremely well ; they give to agriculturists definite accurate measurements of certain aspects of the weather every day, or even several times a day, right through the season. Agriculturists can, of course, measure yield with considerable statistical accuracy, but if no more than the yield is recorded the work is very incomplete. They should follow the meteorologists and give a series of numerical records from their plants right through the season.

Yield is most confusing ; it is the final expression or resultant of growth. It can never be understood unless growth is understood. Agriculturists must contribute systematic observations on growth, and, as every day counts in the plant's life, the plant must be studied every day.

In addition to the weather, the soil and the farming procedure influence the plant, so that the study must be carried out on different soils and under different farming conditions. The present crop weather scheme provides for this and also for uniformity in crop observations. Difficulties met with in taking observations are apt to upset observers' schemes of recording, and consequently the greatest possible effort should be made to conform to specified procedure. The study should also pay the greatest possible attention to agricultural circumstances ; the effect of weather on wheat following clover, for instance, may be different from that on wheat following fallow.

Growth is never smooth ; it proceeds, as it were, by jumps ; constant attention is necessary to perceive and appreciate the importance of the various stages.

Some instances may be given of the importance of knowing all the factors influencing yield. Three wheat varieties sown under similar conditions in 1924 and 1925 germinated in 25 days in 1924 and in 58 days in 1925 ; delayed germination in the latter year was due to frost after sowing. In 1924 on three plots the number of plants surviving in an investigation was 180, 176, and 165 ; in 1925 the numbers were respectively 116, 114, and 84. In another case 88 per cent. of plants were attacked by wheat bulb fly. Again, at Cambridge dry weather during the last week in April and the first week in May is common and hinders plant development. As a consequence the plant may be unable to take full advantage of succeeding spells of weather which, with a more suitable

May, might have been very favourable to growth. In another year the weather may be favourable throughout. The agriculturist must obtain analytical data upon germination, the number surviving, the spacing of plants, critical periods, disease and pest damage, etc. The plants must be watched throughout life.

It is also important to ascertain whether the general inferences from the observers' own plots or fields are supported by the evidence from fields in the neighbourhood; a practice should therefore be made of carefully studying the fields in the neighbourhood of the crop weather station.

Lastly, continuous observation of plots and fields will undoubtedly indicate plant characteristics and vital relationships that will prove very useful.

Technique of Crop Observations (*Mr. T. Eden*).—It is well known that different observers form different opinions of the progress of crops. For this reason Rothamsted Experimental Station has been compelled to consider the possibility of making metrical observations of crops.

Observations on crops can be made in two ways. The present crop weather scheme provides for records of the date of sowing, date of brairding, date of four-leaf stage (in spring oats), and so on. This method of observation is difficult because plants do not come up regularly and the fixing of a criterion is not easy. It seemed preferable, however, to Rothamsted workers to adopt a second method of observation, *viz.*, to go out on to the plots or fields regularly and obtain as many measurements as possible of the conditions of crops on the plots or fields. It is easier to say that on a certain date 20 per cent. of the plants had put out one subsidiary tiller than to fix the date when the average tiller production was, for example, one.

It is necessary to follow the growth of the plant and analyze out the factors contributing to yield. Metrical observations give more information than phenological observations because they provide a series of *comparable* growth data—such as number of tillers, height, etc., all easily measurable—the latest of which are brought about by weather and by previous growth stages. The following characters can be rcommended at this stage as giving the best measure of performance of the plant:—

(1) The capacity of the plant to tiller. There is a high correlation between tillering and the total yield; in fact, tillering is a better indication of yield than the number of ears before harvest. It is worth while spending a good deal of time and care on records of tillering.

(2) The character of the leaf. Some plants will produce a large and some a small amount of leaf. In Rothamsted work the total number of leaves on the main stem and the width of the topmost fully opened leaf were recorded.

(3) The total height of the plant. The total height and shoot height, *i.e.*, height to the last developed leaf and also ear height, were taken on Hoos Field. The total height will probably tell all we want to know about the plant in the first instance.

The next question that arises is how the characters shall be recorded and with what sort of accuracy. At Rothamsted twenty rows of one metre each have been taken and averaged ; 100 records in all have been averaged for height. Four stations —Rothamsted, Cambridge, and two crop-testing stations— are conducting special investigations in the next two years in connexion with crop observations for the agricultural meteorological scheme. It is hoped, as a result of these investigations to introduce improvements in the present crop-reading scheme.

(*To be continued.*)

TRIALS OF TAR-DISTILLATE WASHES IN THE WEST MIDLANDS

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FOR similar reasons to those which decided the holding of trials of Tar-Distillate Washes in East Anglia* it had been decided, quite independently, to carry out large scale experiments in the West Midland Province with some of the better-known makes of these washes. The results of these experiments in 1925 and again this year will be of interest for purposes of comparison.

Arrangement of the Experiments.—The scheme of the experiments was formulated at a Joint Provincial Conference as a result of discussion between the College and County Staffs of the West Midland Province and members of the Long Ashton Staff. In 1925 the trials were carried out at each centre on precisely the same lines, and with the same washes. The results in this year were arrived at after a joint marking of the trees in consultation with Mr. A. H. Lees, of the Long Ashton Station. The 1926 trials were a modification of those in 1925, various alterations being introduced as a result of conclusions drawn from the 1925 trials.

* See this JOURNAL, July, 1926, page 332 ; and October, 1926, page 592.

As far as possible, trees were chosen which could be sprayed so as to ensure even wetting, although, in the case of damsons and some plums, this is a difficult matter. In the majority of cases spraying was carried out with pneumatic knapsack machines. Wherever possible the trees were arranged in chequer board fashion, the controls being so distributed as to minimise the risk of drift.

The 1925 Experiments.—Details of the centres at which the trials were carried out are given in Table I below. For convenience in the arrangement of following tables, each of these orchards is indicated by a key letter, A, B, C, etc. In no case had tar-distillate washes been previously used on any of the trees.

TABLE I.—1925 TRIALS

Key Letter	Situation of Orchard	Fruit	Arrangement	Date of Spraying	Date of Examination
A ..	Mr. Menzies, Groundslow, Staffs.	Apples ..	2 trees, 6 times repeated. In lines.	Jan. 27–Feb. 16.	April 28
B ..	Mr. Hunt, Risingbrook, Staffs.	Apples ..	2 trees, 6 times repeated. Chequer.	Feb. 4 ..	April 28
C ..	Mr. Thurston, Pattingham, Staffs.	Damsons	2 trees, 6 times repeated. Chequer.	Feb. 5–Feb. 16.	April 29 May 15 June 9
D ..	Lord Stafford, Swynnerton, Staffs.	Apples ..	2 trees, 6 times repeated. In lines.	Jan. 30–Feb. 16.	April 28
E .	Mrs. Bailey, Romsley, Salop.	Plums and Damsons.	2 trees, 6 times repeated. Chequer.	Feb. 16–Feb. 20.	April 29
F ..	Mr. Jones, Claverley, Salop.	Apples ..	2 trees, 6 times repeated. Chequer.	Feb. 9 ..	April 29
G ..	Mr. Lane, Bidford-on-Avon, Warwick.	Apples and Plums.	6 trees. Lines.	Feb. 4 ..	April 27
H ..	County Fruit Plot, Hatton, Warwick.	Apples and Plums.	2 trees, 6 times repeated. Chequer.	Jan. 24 and 26, Feb. 13.	April 27

STRENGTH OF WASH.—The five brands of wash employed were each used at 4 per cent. and 8 per cent. strength.

TABLES OF RESULTS.—In two cases, the trade names of the washes are given in the following tables, permission for publication having been obtained from the makers. The other three washes used, denoted by the letters X, Y, and Z, have since been withdrawn from the market or their composition altered. The system of marking is indicated in the note at the head of each table.

TABLE II (1925 TRIALS.) APPLES

Wash at 8 per cent strength

NOTE.—In the table below a figure 10 *indicates a very heavy attack*, 5, *a moderately severe attack*, *and* 1, *a very slight attack. Intermediate figures have corresponding values*

Wash	Aphis					Psylla					Caterpillar					Capsid				
	Orchard				Av	Orchard				Av	Orchard				Av	Orchard				Av.
	A	B	F	G		A	B	F	G		A	B	F	G		A	B	F	G	
Control	5	8	6	5	6	—	4	2	—	3	3	6	8	1	4 5	—	6	—	—	6
Carbo-krimp	0	3	0	0	7	—	1	0	—	5	0	2	2	1	1 2		3	—	—	3
Wash X	2	7	5	1 5	3 9	—	4	1	—	2 5	5	4	4	1	3 5	—	0?	—	—	0?
Mortegg	1	1	0	0	5	—	1	0	—	5	0	1	1	1	7	—	1	—	—	1
Wash Y	0	1	1	0	5	—	1	0	—	5	1	2	3	1	1 7	—	0	—	—	0
Wash Z	1	2	2	1	1 5	—	1	1	—	1	4	2	6	1	3 2		0	—	—	0

TABLE III.—(1925 TRIALS.) APPLES

Wash at 4 per cent. strength

NOTE.—In the table below a figure 10 *indicates a very heavy attack*, 5, *a moderately severe attack*, *and* 1, *a very slight attack. Intermediate figures have corresponding values.*

Wash	Aphis					Psylla					Caterpillar					Capsid				
	Orchard				Av	Orchard				Av.	Orchard				Av.	Orchard				Av.
	A	B	F	G		A	B	F	G		A	B	F	G		A	B	F	G	
Control ..	5	8	6	5	6	—	4	2	—	3	3	6	8	1	4·5	—	6	—	—	6
Carbo-krimp	0	4	0	0	1	—	1	1	—	1	1	3	4	1	2·2	—	3	—	—	3
Wash X	6	7	7	4	6	—	5	1	—	3	1	4	6	2	3·2	—	0?	—	—	0?
Mortegg	0	2	0	3	1·2	—	1	0	—	·5	0	3	3	2	2	—	2	—	—	2
Wash Y	0	5	1	0	1·5	—	1	1	—	1	1	4	4	1	2·5	—	1	—	—	1
Wash Z	2	6	4	2	3·5	—	1	1	—	1	1	4	6	2	3·2	—	2	—	—	2

TABLE IV.—(1925 TRIALS.) PLUMS AND DAMSONS

NOTE.—In the table below a figure 10 *indicates a very heavy attack;* 5, *a moderately severe attack; and* 1, *a very slight attack. Intermediate figures have corresponding values.*

Wash	Wash at 8 per cent. strength								Wash at 4 per cent. strength							
	Aphis				Caterpillar				Aphis				Caterpillar			
	Orchard			Av.	Orchard			Av.	Orchard			Av.	Orchard			Av.
	C	E	G		C	E	G		C	E	G		C	E	G	
Control	10	2	5	5·6	—	3	1	2	10	2	5	5·6	—	3	1	2
Carbokrimp	2	0	0	·6	—	1	1	1	3	0	0	1	—	1	1	1
Wash X	6	0	1·5	2 5	—	2	1	1·5	5	1·5	4	3·5	—	2	1 5	1·8
Mortegg	3	0	0	1	—	1	1	1	2	0	3	1·7	—	1	0	·5
Wash Y	1	0	0	3	—	1	1	1	5	1	0	2	—	1 5	0	·7
Wash Z	6	1	1	2·6	—	1 5	1	1 2	3	1 5	2	2 2	—	2	1	1 5

CONCLUSIONS FROM THE EXPERIMENTS ON APPLES.—The two washes, Mortegg and Carbokrimp, stand out prominently as being of greater value than all the others. Although at 4 per cent. strength, the "kill" obtained against Aphis and Apple Sucker (*Psylla mali*) is very high, this strength is found to have little effect upon the Caterpillar attack, for which 8 per cent. strength gives much more satisfactory results. It must be remembered here that the attack by "Caterpillar," as the fruit-grower understands it, depends on the species of moth which is prevalent. Eggs may be laid from November until March or April as the three chief species of winter moths hatch. It is obvious, then, that only eggs laid before spraying will be affected, so that while the Caterpillars of the Winter Moth (*Cheimatobia brumata*) and the Mottled Umber (*Hybernia defoliaria*) might be reduced in numbers, those of the March Moth would probably escape. There is, moreover, evidence to support the belief that the Winter Moth may emerge over a very long period, in which case eggs may be laid after spraying. An actual case of the late appearance of Winter Moth was encountered in Orchard D. In such conditions it might appear that the wash had failed to kill.

So far as Capsid Bug is concerned, in the only orchard in which this pest was found, the infestation was so light and uneven that the figures given are probably unreliable (see 1926 figures).

Wash Y, at 8 per cent. strength, appears almost as effective in its killing power as Mortegg and Carbokrimp. This wash, however, was put on the market for use at $3\frac{1}{2}$ per cent. strength,

so that its expense at 8 per cent. at once makes it uneconomical in use. At 4 per cent. it proved to be of little value.

CONCLUSIONS FROM EXPERIMENTS ON PLUMS AND DAMSONS. —Mortegg and Carbokrimp again head the list in the control of leaf-curling plum Aphis and Caterpillar. It is sometimes very difficult, however, to estimate an attack of Caterpillar when a large amount of Aphis curling is present, but there seems no reason to suppose that the Winter Moth eggs on plum should be any more or less resistant than those on apples.

One most important point is the effect which these washes have in suppressing the blossom on the trees. It was most obvious in orchards C and G that the washes, which were effective in controlling Aphis, almost completely prevented blossoming. The foliage was extremely healthy in appearance and the young growth vigorous, but there was no crop. On the Controls and those trees sprayed with ineffective washes there was a heavy Aphis attack but a moderate crop of plums. It is worthy of note, however, that in 1926 these same trees showed a remarkable difference. Those on which the blossom had been suppressed were carrying an excellent crop, very much superior to that on the other trees. These trees received no winter spraying and there was no attack of Aphis in those orchards at all in 1926, though this latter fact is probably merely a coincidence. On the damsons in orchard C, while the sprayed trees carried no blossom, the crop which set on the Controls was destroyed entirely by the very heavy Aphis attack.

The Experiments in 1926.—Washes X, Y. and Z, having failed in 1925 and been withdrawn from the market, it was decided to omit these in 1926 and pursue the trials with Mortegg and Carbokrimp at 4, 8, and 10 per cent. The 10 per cent. strength was included with the idea of ascertaining whether or not Caterpillar and Capsid Bug (*Plesiocoris rugicollis*) could be controlled more effectively by it.

SYSTEM OF MARKING.—A different scheme of marking of the trees was introduced. Every tree was examined and the figure given is the average one.

(1) *Winter Moth and Tortrix Caterpillars.*—The figure is an estimate of the actual number of Caterpillars per tree. On small trees this number is not difficult to arrive at, especially if the infestation is only moderate. Careful counts were made on approximately one-third of the tree within easy reach and it was assumed that the distribution was similar over the remainder of the tree.

(2) *Apple Sucker and Apple Aphis.*—As in the 1925 Trials a figure of ten was given where infestation was very severe, with gradations down to one where it was very light; "Tr." indicates " a trace " something less than one, and it is probable here that such insects hatched from occasional eggs, untouched by the wash.

(3) *Leaf-Curling Plum Aphis.*—The figure indicates the percentage of leaves on the tree showing curling.

(4) *Capsid Bug.*—The figure indicates the percentage of leaf-trusses showing the characteristic marking. This figure is easily obtained if examination is done when the blossom is in the pink stage and not open.

TABLE V.- 1926 TRIALS

Key Letter	Situation of orchard	Fruit	Arrangement of Trees	Date of Spraying	Date of Examination
A ..	Mr. J. D. Lane, Bidford-on-Avon, Warwick.	Apples and Plums	12 trees in 2 lines of 6.	Jan. 27 Feb. 1.	April 15
B ..	Mr. Percival, Rodbaston, Staffs	Apples	2 trees, 6 times repeated. Chequer	Feb 26 Mar. 2.	April 23
C ..	Mr. Jones, Ludstone, Salop	Apples and Plums	2 trees, 6 times repeated. Chequer.	Feb 1 Feb 8.	April 28
D ..	Mrs. Byron, Hillside, Denstone, Staffs.	Damsons	2 trees, 6 times repeated Chequer.	Feb. 18 Feb. 23 Feb. 25.	April 29

CONCLUSIONS FROM EXPERIMENTS ON APPLES.—Both washes at 10 per cent. strength show a remarkable efficiency. Apple Sucker and Aphis are, practically speaking, wiped out, while the numbers of Tortrix and Winter Moth Caterpillars show a marked reduction. On Capsid Bug also an excellent control was obtained in the one orchard where this insect was present. The trees, Cox's Orange Pippin, were known to be heavily attacked as a rule. Two independent observers made these counts and arrived at figures which were practically identical.

CONCLUSIONS FROM EXPERIMENTS ON PLUMS AND DAMSONS. —Both washes again proved very effective at 8 per cent. and 10 per cent. against Leaf-Curling Plum Aphis and Winter Moth Caterpillars. In orchard D rain interfered with the

TABLE VI.—(1926 TRIALS.) APPLES.

NOTE.—In the table below the figures under—

Winter Moth Caterpillars and Tortrix Caterpillars represent the actual number of caterpillars on the average per tree.

Apple Sucker (*Psylla mali*), *Aphis pomi and Aphis roseus* indicate the intensity of attack, a figure of 10 being awarded for a very heavy attack with gradations down to 1, which shows a very slight attack.

Capsid indicate the percentage of leaf trusses on the tree showing the markings made by this bug.

In all cases where only a very occasional insect was found the abbreviation "Tr." is used, indicating "a trace."

Wash		Winter moth caterpillars				Tortrix caterpillars				Psylla				A. pomi				A. roseus				Capsid			
	Strength	A	B	C	Av.	A	B	C	Av	A	B	C	Av	A	B	C	Av	A	B	C	Av.	A	B	C	Av.
	per cent.																								
Mortegg	10	1·5	2·5	10	4·7	·5	—	—	—	-		—	—	—	—	·6	·2	—	—	—	—	2-3	—	—	—
	8	2·29	3·8	8	4 7	1	—	—	-	-	-	—	—	—	Tr	4	·14	—	—	—	—	12	—	—	—
	4	4	7	20	10·3	2·5	—	—	—	—		—	--	—	Tr.	3	·1	—	—	—	—	33	—	—	—
Carbokrimp	10	2·5	4·4	5·5	4·1	5	—	--	—	—		—	—	—	—	·12	04	—	—	—	—	2–3	—	—	—
	8	1·5	4·1	18	7·9	1	--	—	—	-	—	—	—	—	Tr.	16	·06	—	—	—	—	20	—	—	—
	4	7	9 5	18	11 5	4	—	—	—	Tr.	—	—	—	—	Tr	2	6	—	—	—	—	33	—	—	—
Control ..	—	30	14	66	36 6	10	—	—	—	Tr.	2	-	—	Tr.	4	6	5	Tr.	—	—	—	33	—	—	—

TABLE VII.—(1926 TRIALS.) PLUMS AND DAMSONS

NOTE.—In the table below the figures under—

Aphis show the percentage of leaves on the tree which were curled.

Caterpillar represent the actual number of caterpillars on the average per tree.

Wash		Aphis Percentage of leaves curled			Winter moth caterpillars. Number
	Strength per cent.	C.	D.	Av.	C.
Mortegg ..	10	·4	Tr.	·2	7
	8	·3	Tr.	·15	7·9
	4	·3	·6	·45	24
Carbokrimp	10	·27	1 6	1·6	10
	8	·19	4	2·1	11·3
	4	2	2·6	2·3	18
Control ..	—	90	60–70	75	200

application of 10 and 8 per cent. Carbokrimp and this was, therefore, probably less effective than it might have been at those strengths. In orchard C the effect on Winter Moth Caterpillars was very marked, the control trees being easily recognizable from a distance on account of the severely curled and depleted foliage.

At C (plums) a slight reduction of the amount of bloom was observed on trees sprayed with both washes at 8 and 10 per cent. strength. At D (damsons), while there was little difference in the amount of bloom, the higher strengths of both washes definitely retarded blossoming, and in the case of the trees sprayed with 10 per cent. these were in full bloom a fortnight after the controls. This retardation may prove a factor in enabling a crop of damsons to be obtained more regularly, since early blossoming followed by frost is frequently responsible for a total loss of fruit.

GENERAL CONCLUSIONS FROM THE TWO YEARS' TRIALS.—*Apples.*—Of the washes which have been tested, Mortegg and Carbokrimp have proved easily the most effective. These two washes have also been found effective by Petherbridge in East Anglia (see this JOURNAL, July and October, 1926).

The eggs of Aphides, Apple Sucker and, to some extent, Winter Moth and Tortricids are killed by these washes at 4 and 8 per cent., but a concentration of 10 per cent. is considered most effective and is also far more deadly against Capsid Bug eggs. In no case has any damage been observed to

buds sprayed with 10 per cent. provided that they are dormant at the time of application.

For reasons discussed previously it is seldom if ever possible to control Winter Moth Caterpillars completely by these washes, but they may be greatly reduced.

In order to avoid the tarry scum which may form when these washes are used at 10 per cent., it is recommended that, where possible, they should be made up with soft water. The scum causes considerable damage to the rubber working parts of pumps, etc.

Plums and Damsons.—Mortegg and Carbokrimp are the most effective washes which have been used against the Leaf Curling Plum Aphis. Their effect on Winter Moth Caterpillar on plums is precisely the same as with that insect on apples.

At 8 and 10 per cent. both these washes either suppress completely or retard the development of the blossom buds. Damsons appear to be more susceptible to damage than plums and, in order to avoid this trouble, the washes should not be used at a greater strength than 6 per cent. This should be applied when the buds are absolutely dormant and never later than the end of January.

In all cases it is most important that the small bud-bearing twigs should be thoroughly sprayed, since the eggs are found almost entirely on these. The larger branches and trunk need no spraying except for cleaning purposes.

Thanks are due to Messrs. Malthouse, Stoney and Dunkin, the County Horticultural Organizers for Shropshire, Staffordshire and Warwickshire respectively, for their co-operation in the trials.

NOVEMBER ON THE FARM

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Seasonal Notes.—This was the Wind-monath of our Anglo-Saxon ancestors, who named the months according to their outstanding features. The stormy character of November, however, is perhaps magnified by the fall of the leaf with which it is associated. During each of the past six years the weather of this month has been comparatively dry, excepting 1923, when the total precipitation was only slightly below the average for 1900-1920. How long this cycle of dry Novembers will last no one knows; but such conditions are certainly

abnormal for this month, the days of which are generally cold and damp. Proverbially there should be a few fine warm days about the 11th day, "St. Martin's summer"; but a clear sunset at this time is supposed to foreshadow a severe winter.

The harvesting of potatoes and mangolds should be completed early in November, as severe frosts frequently begin to occur after about the first week in the month. Moreover, it is desirable not to defer the sowing of the land with wheat or winter oats, especially on potato tilths, which do not remain sowable for long. The seed should not be covered deeply at this time of the year; deep covering delays germination and has an effect opposite to that desired in the matter of protection from frost injury. On the other hand, late-sown seed corn is frequently troubled by the birds, and the desire to sow shallow must be tempered by this consideration. October generally is a better month than November for wheat sowing; but in favour of the latter it is sometimes urged that on rich land the proportion of grain to straw is higher in the later sowings and that the crop is less liable to be smutted. Sometimes also early sowing is not practised because of the fear of twitch or couch infestation.

It is rather remarkable that peas and the less hardy kinds of winter oats survive the winter better when sown in November than when sown in October. The less lushy tissues associated with germination at the lower temperatures of the later month are less susceptible to frost injury; but the fundamental differences in cell structure and composition which make a plant susceptible or resistant to frost are not yet understood.

November is the usual time for lifting and storing swedes for cattle feeding. Where the crop is fed on the land it is customary in some districts not to lift and cut the crop; but elsewhere it is believed to be sound economy to feed the roots from troughs and to store at least a sufficient quantity to carry the flock over frosty periods. Whether the roots keep better in the pit or in the field depends on conditions. On heavy soils and on other soils where the intention is to sow winter corn the crop is necessarily lifted and pitted; but where conditions permit of it there is something in favour of pulling the roots and transposing them two or more rows into a newly ploughed furrow and turning the earth back on to them with the plough. In an experiment, conducted by the West of Scotland Agricultural College, in the winter of 1924-25, it was found that the yield per acre increased from

21 tons in mid-November to 25 tons in March where the crop was so treated, as compared with a slight loss in the pitted swedes and a slight gain over the November weight where the crop was left unpulled in the drill rows.

Soil Cultivation.—In a paper read before the Farmers' Club last November attention was called to the paucity of systematic experiments on tillage in its relation to crop yields. The study of the physical properties of soils and soil constituents has, until recent years, received less attention than the chemical aspects of crop production ; and it must be admitted that, owing to the variable texture of soils and subsoils and the great influence of climatic conditions on the soil's behaviour, the translation of laboratory findings into field experiments and practice is in this matter particularly difficult. Nevertheless progress is being made in the solution of tillage problems, although our knowledge may as yet suggest little beyond what observant farmers already know.

Ploughing is the basic tillage operation and differs from other methods of working the soil in the fact that it effects more or less inversion of the soil layers. The actual need for this inversion has indeed been questioned, and one experimenter—Jean, in the South of France—claims to have been able to dispense with ploughing entirely, securing the requisite depth of tilth by the use of tine implements only. Most farmers, however, when ploughing stubbles at this time of the year have as one of their chief objects that of placing surface growth out of reach of light and air ; and besides using the skim coulter they may—in their desire to cover the weeds thoroughly—plough a deeper and more completely inverted furrow than they would otherwise consider necessary.

There is undoubtedly a difference in the results of autumn ploughing according to whether the furrow is turned completely over or set up more or less on its edge ; and on heavy soils these differences are the more noticeable in the following spring when the work has been deep and the weather mild and humid during the winter. The set-up furrow is earlier ready for spring operations and more readily works down to a tilth than the flat work, which may have run together and become very saddened.

It is obvious that, when the furrow is completely inverted, the lower layers of the soil are brought to the surface, whereas, when the furrow is set up at an angle, there is still a considerable proportion of the old top soil near the surface. This

may or may not be advantageous according to whether it is desirable to make the surface soil less or more cohesive. Owing to the tendency of the colloidal—glue-like—constituents of the soil to work downwards, the lower layers of the soil become heavier and more cohesive than the upper layers. On light soil therefore a deep flat furrow may result in improved texture. On stiff soil, however, such a furrow may raise the proportion of colloidal matter in the surface layers to such an extent as to make it very difficult to obtain a satisfactory tilth. Clearly therefore the set-up furrow is preferable on heavy soils, especially when ploughing rather deeply and in wet districts.

The risks involved in and the power required for the deep ploughing of heavy soils are well known. On the other hand, adherence to shallow ploughing in this case brings on another trouble, *viz.*, the formation of an injurious impermeable "pan" just below the layer ordinarily worked. This appears to be caused not by the friction of the plough-sole but by the accumulation at this level of the colloidal constituents washed down from the loosened soil. Various methods have been advocated—including subsoiling—for the dispersion of this pan. The gardener can deal with it by bastard trenching, whereby he actually inverts this under layer and places the pan material a spit lower down in the subsoil. Hitherto it has been impossible to imitate this with field implements, but recently a German worker has designed a form of double plough which he claims to be capable of accomplishing the desired result. Although the subsoiling breast is placed behind (and below) the breast that turns the top soil, it inverts the subsoil before the top soil furrow falls over. The former is a short bluff breast which turns the furrow quickly, whereas the latter is a long breast which holds the top soil until the subsoil furrow has been turned.

Cow-stalls.—The proper width of stall for cows of average Shorthorn size when tied to a side-stay is 6 ft. 6 in. for each pair. If a greater width is allowed, unless a post is fixed midway between each pair of "bosgins" or partitions, the cows are able to turn their hind quarters too far round; with narrower stalls, however, there is risk of a cow treading on her neighbour's teats—I have known four such cases to occur in the same herd in one winter.

The question of the length of standing calls for further explanation, as some readers are of opinion that 5 ft. to 5 ft.

6 in. is insufficient. This is likely to be the case where the tie stay is fixed several inches behind the edge of the manger and not opposite the manger side as illustrated in last month's notes. A common error in this connection may here be mentioned, *viz.*, that of sloping the tie-stay backwards so that the cow moves forward when eating and has to stand back when her head is up. Generally if any slope at all is given it should be forwards, the top of the stay being about three inches nearer the front of the stall than the lower end. An exception must be made, however, in sheds where the cows stand with their heads to the wall without a fore-passage between. Here the tie-stay cannot be sloped forward unless it is placed behind the manger. otherwise the cow's head when raised will be brought too near the wall.

Tubular partitions and stanchion ties have certain advantages: they are more easily kept clean than boarded divisions; the cows, being placed in the middle of their stalls, cannot horn each other as they often can over the top of a "bosgin"; and they allow of each animal being given a width of 3 ft. 6 in. without being able to turn too far round. However, they are not so convenient as the usual arrangement in sheds that have not a fore-passage for feeding purposes. The criticism against stanchion ties is that they are prone to cause big knees, owing to the cows striking them with their fore-legs on rising; and it is more difficult to drench a cow held in a stanchion than in a common tie.

Horse Breeding.—The slight but appreciable improvement in demand and prices of foals at sales this autumn raises the question of whether the limit to the reduction in numbers of horses has been reached. Since 1913 the number of horses used for agricultural purposes has declined in England and Wales from 807,316 in that year to 760,500 in 1926, and the number of foals from 105,854 to 41,000. It cannot be said that tractors have displaced many horses or that they are likely to displace many in the near future. If therefore 760,000 is near the minimum number requisite for farm purposes then 41,000 foals per annum is insufficient to maintain the number required for farm work alone: for the average working life of a horse is not so much as nineteen years.

NOTES ON MANURES FOR NOVEMBER

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Manures for Pastures.—It should be borne in mind that proper cultivation and skilful stocking play at least as important a part in the maintenance and improvement of pasture as the application of fertilizers. In some areas liming is also a necessary operation, as, for example, on certain soils of the Coal Measures and Millstone Grit in the West Riding of Yorkshire ; but on the whole the need for lime is less frequent under grass than in arable conditions.

Phosphates.—As far as manuring is concerned the primary need of the bulk of our poorer grass land is phosphate. Sufficient potash is derived in the majority of cases from the clay constituents of the soil, and the necessary nitrogen is largely obtained from the atmosphere by the agency of leguminous plants. Experiments at Cockle Park (1897 and onwards) and elsewhere had shown that under a wide range of grassland conditions a dressing of 10 cwt. per acre of high-grade basic slag, providing about 440 lb. of phosphate of lime, was usually followed by a very marked improvement, which was maintained by subsequent dressings of about half the quantity of slag given as the need arose. Recent work indicates that equivalent dressings of phosphate applied in the form of the lower-grade slags now available or as finely ground rock phosphates produce very similar results. The rock phosphates have the merit of cheapness, and certain forms of finely ground Northern African phosphate are steadily gaining in favour, especially in the northerly and westerly districts. There is evidence that basic slags made with the addition of fluorspar, while of distinct value, are less effective than the other forms mentioned. Superphosphate, which at present provides water-soluble phosphate at much the same price as the total phosphate of basic slags of the same grade, suits soils well supplied with lime and can work under conditions which would be too dry for the less soluble forms. Farmers are often reluctant to provide the rather heavy dressings of low-grade slags corresponding to the former applications of 40 per cent. material. This tendency is less in the case of rock phosphates because of their high phosphate content. A dressing providing about 220 lb. per acre of phosphate of lime may be regarded as a desirable standard for land under regular phosphatic treatment. This would correspond roughly

to 10 cwt. of 20 per cent. slag, or 7 cwt. of 30 per cent. slag, or $3\frac{1}{2}$ cwt. of 60 per cent. rock phosphate per acre. If smaller dressings are given they will have to be renewed at shorter intervals.

Potash.—On many medium and heavy soils phosphate alone will produce the necessary improvement in grazing land, but cases occur, particularly on light or on peaty soils, where an addition of potash is advisable. This can best be decided by a small scale trial on the land in question. A dressing of about $1\frac{1}{2}$ cwt. per acre of 30 per cent. potash salts or its equivalent of the lower grades, given in autumn in alternate years, will usually meet such cases.

Nitrogen.—Until recently the view that direct applications of nitrogenous manures should be withheld from grazing land and that the residues of any concentrates fed would provide all the nitrogen required received no very serious challenge. Attention is now being directed to the possibility of adapting to English conditions an intensive system of grass-land husbandry developed in Germany during the last years of the war. The grass, which is divided into a number of small enclosures to permit of control over the grazing, receives a generous autumn dressing of phosphate and potash and a series of nitrogenous top dressings at intervals during the spring. The flushes of grass thus produced are grazed when hand high, using a heavy stocking per acre (usually dairy cattle), the stock being passed from one enclosure to another every few days, always passing to fresh, young grass and leaving the used land to recuperate or be grazed by rougher stock. It is claimed that the carrying capacity of the land is considerably increased and that the young grass taken in the leafy stage forms a highly nitrogenous food which largely reduces the need for purchased concentrates. The system has recently been described and examined from the English standpoint.* Experiments are in progress at various centres and the results are awaited with interest.

Manurial Residues.—The residual effects of certain fertilizers when used at ordinary farming rates have been ascertained in several well-known field experiments, of which that on Little Hoos rotation field at Rothamsted is perhaps the best known. Under the more intensive conditions of market gardening information on the residual action of dung and of artificials,

* This JOURNAL, September, 1926; *Farmer and Stockbreeder*, August 23, 1926.

alone and in combination, is provided by the results of the last years of Dyer and Shrivell's well-known manurial experiments on vegetable crops carried out on a heavy soil in Kent.*

After about eighteen yearly applications of a series of combinations of London dung and mixtures of artificials to vegetable crops, the treatments were all stopped and the cropping was continued for five seasons without further manures. Dung was applied each year at 25 tons and also at 12½ tons per acre, and the heaviest dressing of artificials used was approximately 7 cwt. superphosphate or slag, 1 cwt. sulphate of potash or 4 cwt. kainit, and 8 cwt. of nitrate of soda per acre per annum.

The table below is derived from some of the results and only indicates the general trend of the figures. There were no unmanured plots, so that yields have been expressed in terms of the average performance of the heavily dunged plots over thirteen years of manurial treatment.

No. of years after manuring ceased.	No. of different crops weighed.	Av. yield of these crops in last 13 seasons with 25 tons dung yearly.	Residues in 19th-23rd years, after 18 annual dressings of:— 25 tons dung	12½ tons dung	12½ tons dung and complete artificials	Complete artificials only.
1 .	9	100	74	55	86	69
2 ..	7	100	62	46	60	50
3 ..	5	100	50	40	46	35
4 .	8	100	57	44	55	38
5 .	4	100	37	27	36	26

In spite of irregularities arising out of the effect of season the figures show a fairly uniform decline from the level of the first year and reflect the authors' conclusions as set out in their publication. The half dressing of dung, plus complete artificials, appears to hold out as well as the heavy dressing of dung alone. The residues of the complete artificial dressing are on the whole inferior to those of the light dressing of dung. The greater lasting power of the large dressing of dung as compared with the half dressing is well shown. The figures also bring out how dependent is intensive culture on the continual addition of plant food, for in the course of five years without manures production had fallen to about one-third of its original high value.

* See Dyer & Shrivell: *The Manuring of Market Garden Crops*, 1924.

Phosphates for Clover.—The effect of basic slag and other phosphates in improving heavy grass land is well known. It is perhaps not so generally recognised that if for any reason the improved sod comes back under the plough much better results are obtained than from untreated grass. The results of an experiment conducted at Saxmundham, in Suffolk, on a clay soil with a pronounced need for phosphate treatment bring out this point. Part of the grass was slagged at the rate of 10 cwt. per acre in 1904 and again in 1912, the remainder being untreated. The slag produced very profitable returns as measured by the increased value of the grazing, and when the turf was broken up the following yields were obtained under arable cropping :—

Manuring to grass 1904 and 1912	1919 Beans and Peas	1920 Wheat	1921 Barley	1922 Mangolds
No manure	30 bus.	29 bus.	31 bus.	23 tons
10 cwt. slag	40 bus.	39 bus.	43 bus.	26 tons

The figures show how much richer the slagged turf was than the untreated sod, largely due to the nitrogen brought in by the clover in the improved herbage.

It has been shown in other parts of the country that similar effects are obtained on breaking up temporary grass on which phosphates had been used. In fact this enrichment may actually be troublesome in some districts, for oats following an old ley which was very full of clover may lodge in a wet season. In the drier parts of the country there is little risk from this cause and phosphates applied to a one-year clover ley usually benefit the wheat, as the following figures, also from Saxmundham, show :—

Manures to young clover Winter, 1913	Clover hay 1914	Wheat 1915
None	3 cwt.	20 bus.
5 cwt. slag	51 cwt.	27 bus.
4 cwt. superphosphate	56 cwt.	25 bus.

In this case some of the benefit to the wheat has been due to the residual effects from the phosphates, but no doubt the chief agent was the clover sod. Phosphates are commonly applied in their first autumn to the longer leys of the wetter parts of the country, using about the same dressings as for the permanent grass. For the one-year leys of the south-east a light dressing of phosphate may be applied in autumn ; or where there is little risk of vigorous growth of clover causing trouble in the sheaves at harvest, the nurse crop sometimes receives enough phosphate to meet its own needs and leave a residue for the seedling clover.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns name and are net cash for prompt delivery.

Description	Average price per ton during week ending October 13				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	..	12 10	12 10	12 10	16 2
Sulphate of ammonia—					
Neutral (N. 20·6%)	11 9*	11 9*	11 9*	11 9*	11 1
Calcium cyanamide (N. 19%) ..	9 6	9 6	9 6	9 6	9 9
Kainit (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	3 12	3 0	3 9	3 3	3 2
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51¼%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 34%)	..	..	3 8§	..	..
„ (T.P. 30%)	..	3 2§	3 3§	3 6§	2 2
„ (T.P. 28%)	..	2 11§	..	..	..
„ (T.P. 26%)	..	2 7§	..	..	..
„ (T.P. 24%)	..	2 2§	2 3§	2 11§	2 1
Ground rock phosphate (T.P. 58%)	2 10¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 0	3 5	1 10
„ (S.P. 33%) ..	..	..	3 6	..	..
„ (S.P. 30%) ..	3 0	2 10	3 2	2 18	1 11
Bone meal (N. 3¾%, T.P. 45%) ..	8 10	8 5	8 10	8 0	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 0†	6 10†	5 15	5 10	..
Burnt lump lime	2 0	1 12*a*	2 0*b*	2 1‖	..
Ground lime	2 7	2 1*a*	2 9*b*	1 15‖	..
Ground chalk	..	1 9	..	1 5‖	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash

* Delivered in 4-ton lots at purchaser's nearest railway station

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

‖ Delivered in 4-ton lots to London

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton.

a Delivered to Hull

b Delivered to Liverpool area.

MONTHLY NOTES ON FEEDING STUFFS

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Swedish Experiments in Pig-Breeding for Bacon Production.—At the Swedish Agricultural Experiment Station, under the control of Professor Nils Hansson, an investigation was commenced in 1923 which had for its primary object the testing

of the productivity of Swedish pig-breeding stock, with particular reference to the Swedish Farm Breed and the Swedish Yorkshire Breed. The intention of the investigators was to distinguish those breeds and groups of individuals which passed on to their progeny the qualities of quick growth, good build, excellent utilization of food and the formation of a carcass which produced bacon of an extremely good quality when cured. In a recent bulletin* the results for the years 1923, 1924 and 1925 are brought under critical review, and contain many conclusions of great interest to pig-breeders and pig-feeders. The research material, which was collected from various Swedish pig-breeding centres, included 464 examined and approved test pigs supplied from the best stocks of the Swedish Farm Breed and the Swedish Yorkshire Breed. The most important of the conclusions arrived at were as follows :—

(1) The breeds compared favourably with each other with regard to quickness of growth, excellent utilization of food, yield on slaughtering and quality of bacon produced.

(2) Of the different breeding stocks tested evidence was obtained of very considerable differences in the inherited qualities and the possibility of improving the hereditable qualities of stocks by the suitable interchange of breeding animals.

(3) With regard to the influence of different families and individuals on the productivity of their descendants, the material available shows that individual boars and their families inherit considerably different productivity, and the data also emphasize the importance of subjecting to a critical examination the litters of the same sows by different boars.

(4) With regard to classification of bacon for export, it was found that the long-bodied pigs with a thin layer of back fat tended to fall in Class I, whereas the short-bodied pigs with thick back fat came mostly in Class III.

The Class III type of pig, however, yielded 64·4 per cent. of bacon for export, whereas the Class I type of pig yielded 62·4 per cent. of bacon for export, emphasizing the necessity of giving a distinctly better price for pigs of the Class I type if production of pigs of the Class III type is to be discouraged.

(5) With regard to the influence of the weight of the pig at the time of slaughter on the thickness of the back fat and the quality of bacon produced, interesting results were shown.

* Verksamheten vid försöksstationen for avkastningskontroll inom suinaveln under ar 1925, av Nils Hansson och Sven Bengtssar. Stockholm, 1926.

Thus the thickness of the back fat measured from 1·5 in. in the case of small pigs of 195 lb. weight to 1·7 in. in the case of large pigs of 219 lb. in weight. In addition, 48·9 per cent. of the small pigs of 195 lb. average; 32·1 per cent. of medium pigs, of 198 to 213 lb., and only 20·1 per cent. of large pigs, of 219 lb. average weight, yielded first-quality bacon. The necessity of slaughtering pigs at a comparatively low weight if first-quality bacon is to be hoped for is thus strongly emphasized.

(6) With regard to sex differences, evidence was obtained which showed that sows give a larger percentage of first-quality bacon than boars, the sows being distinctly better as regards the development of belly bacon and hams.

(7) With regard to the influence of body build, the pigs of long body type with deep sides tended to grow much more quickly and to deposit less fat than those of the short body type, with a tendency also to reduction in the development of belly bacon and hams. Pigs with shallow sides produce a larger percentage of exportable bacon, yield less loss on slaughter and have better hams; but these advantages are outweighed by the poorer quality of the bacon produced.

(8) With regard to the normal growth of pigs at different weights, a considerable body of information has accumulated, which for convenience is given in the table which follows, converted to English measures. The pig-breeder and feeder, by comparing the weight gains of his own pigs with this table, will be able to ascertain whether his pigs are equal to, or better than, the best types of Swedish bacon pig.

BREEDING PIGS. ASTORP, 1925

Average weight. lb.	Age in days	Average gain per day. oz.	Food units per lb. gain
39·8	71	14	2·29
55·4	82	17	2·69
77·2	101	20	3·07
98·8	118	22	3·47
121·6	134	25	3·58
144·1	149	24	3·96
165·7	162	26	4·05
187·9	177	26	4·26
202·2	180	26	4·[illegible]9

Several interesting points emerge from this table. First, the food units per lb. live weight gain rise as the pig gets older, so that, as far as food consumption is concerned, the heavier pigs are more expensive to produce. The Swedes are also able to get a pig of 200 lb. live weight in 26 weeks and of 160 lb. live weight in 24 weeks. Four food units, or 4 lb. of cereal meal, are required to produce 1 lb. of pig at

160 lb. live weight, so, assuming 63 per cent. of the pig is converted to bacon, it takes approximately 6½ lb. of meal to produce 1 lb. of bacon.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch equivalent	Protein equivalent	Per ton
	Per cent.	Per cent.	£ s.
Barley	71	6·2	9 2
Maize	81	6·8	7 10
Decorticated ground nut cake	73	41·0	11 10
" cotton cake	71	34·0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2·15 shillings, and per unit protein equivalent, 1·86 shillings.

In accordance with the recommendation of the Departmental Committee on Rationing of Dairy Cows,* the "food values" given in the following table may be taken as applicable to the ensuing four months, December to March, inclusive, for the purposes of advisory schemes on the rationing of dairy cows.

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Roots—			
Kohl Rabi	8	0·5	0 18
Mangolds	7	0·4	0 16
Potatoes	18	0·6	2 0
Swedes	7	0·7	0 16
Turnips	5	0·4	0 11
Green foods—			
Cabbage, drumhead	7	0·9	0 17
" open-leaved . ..	9	1·5	1 2
Kale, marrow stem	9	1·3	1 2
Silage, vetch and oats.. ..	13	1·6	1 11
Hay—			
Clover hay	32	7·0	4 2
Lucerne hay	24	7·9	3 6
Meadow hay, poor	19	2·9	2 6
" " medium ..	31	4·6	3 15
" " very good .	40	7·8	5 0
Seeds hay	24	4·9	3 1
Straws—			
Barley straw	19	0·7	2 2
Bean straw	19	1·7	2 4
Oat straw	17	0·9	1 18
Wheat straw	11	0·1	1 4
Grains and seeds—			
Barley	71	6·2	8 4
Beans	66	20·0	8 19
Oats	60	7·6	7 3
Peas	69	18·0	9 2
Wheat	72	9·6	8 13

* Report obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C. 2, price 6d. net.

DESCRIPTION	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British	—	—	11 10	0 14	10 16	72	3 0	1·61	9·6
Barley, British malting ..	—	—	9 10*	0 11	8 19	71	2 6	1·34	6·2
„ „ feeding ..	—	—	9 0	0 11	8 9	71	2 5	1·29	6·2
„ Canadian No. 4 Western	33 0	400	9 5	0 11	8 14	71	2 5	1·29	6·2
„ Russian .. .	31 9	„	8 19‖	0 11	8 8	71	2 4	1·25	6·2
Oats, English, white	—	—	9 0	0 12	8 8	60	2 10	1·52	7·6
„ „ black and grey	—	—	8 10	0 12	7 18	60	2 8	1·43	7·6
„ Canadian No. 2 Western	30 9	320	10 15	0 12	10 3	60	3 5	1·83	7·6
„ „ No. 3 „ ..	29 3	„	10 5	0 12	9 13	60	3 3	1·74	7·6
„ „ feed	26 9	„	9 7	0 12	8 15	60	2 11	1·56	7·6
„ American	26 6	„	9 5	0 12	8 13	60	2 11	1·56	7·6
„ Argentine	23 9	„	8 7	0 12	7 15	60	2 7	1·38	7·6
„ Chilian	24 3	„	8 10	0 12	7 18	60	2 8	1·43	7·6
Maize, Argentine	32 3	480	7 10	0 11	6 19	81	1 9	0·94	6·8
„ South African	32 0	„	7 10†	0 11	6 19	81	1 9	0·94	6·8
Beans, English winter	—	—	9 10	1 8	8 2	66	2 5	1·29	20
Peas, Japanese	—	—	28 15†	1 5	27 10	69	8 0	4·28	18
Dari, Bombay	—	—	11 10	0 13	10 17	74	2 11	1·56	7·2
Millers' offals—									
Bran, British	—	—	5 12	1 4	4 8	42	2 1	1·12	10
„ broad	—	—	6 10	1 4	5 6	42	2 6	1·34	10
Middlings, fine, imported ..	—	—	8 2	0 19	7 3	69	2 1	1·12	12
„ coarse, British ..	—	—	7 2	0 19	6 3	58	2 1	1·12	11
Pollards, imported	—	—	6 0	1 4	4 16	60	1 6	0·80	11
Meal, barley	—	—	10 5	0 11	9 14	71	2 9	1·47	6·2
„ maize	—	—	8 15	0 11	8 4	81	2 0	1·07	6·8
„ „ germ	—	—	8 10	0 17	7 13	85	1 10	0·98	10
„ „ gluten feed ..	—	—	8 7	1 3	7 4	76	1 11	1·03	19
„ locust bean	—	—	8 0	0 9	7 11	71	2 1	1·12	3·6
„ bean	—	—	12 0	1 8	10 12	66	3 3	1·74	20
„ fish	—	—	19 0	3 15	15 5	53	5 9	3·08	48
Maize, cooked flaked	—	—	10 10	0 11	9 19	85	2 4	1·25	8·6
Linseed	—	—	17 0	1 7	15 13	119	2 8	1·43	19
„ cake, English, 12% oil	—	—	12 10	1 13	10 17	74	2 11	1·56	25
„ „ „ 10% „	—	—	12 5	1 13	10 12	74	2 10	1·52	25
„ „ „ 9% „	—	—	11 15	1 13	10 2	74	2 9	1·47	25
Soya bean „ 6% „	—	—	12 0*	2 7	9 13	69	2 10	1·52	36
Cottonseed cake, English, 5½%„	—	—	6 7	1 8	4 19	42	2 4	1·25	17
„ „ Egyptian, 5½% „	—	—	5 15	1 8	4 7	42	2 1	1·12	17
Decorticated cottonseed meal, 7% oil	—	—	9 15	2 7	7 8	74	2 0	1·07	35
Coconut cake, 6% oil	—	—	8 15	1 7	7 8	79	1 10	0·98	16
Ground nut cake, 6% oil ..	—	—	7 5	1 12	5 13	57	2 0	1·07	27
Decorticated ground nut cake, 7% oil	—	—	11 10*	2 8	9 2	73	2 6	1·34	41
Palm kernel cake, 6% oil ..	—	—	7 5	1 0	6 5	75	1 8	0·89	17
„ „ „ meal, 6% oil	—	—	7 15	1 0	6 15	75	1 10	0·98	17
„ „ meal, 2% oil ..	—	—	6 5	1 1	5 4	71	1 6	0·80	17
Feeding treacle	—	—	5 15	0 9	5 6	51	2 1	1·12	2·7
Brewers' grains, Dried ale ..	—	—	6 7	1 1	5 6	49	2 2	1·16	13
„ „ „ porter ..	—	—	5 17	1 1	4 16	49	2 0	1·07	13
„ „ Wet ale ..	—	—	0 14	0 8	0 6	15	0 5	0·23	4·8
„ „ „ porter ..	—	—	0 11	0 8	0 3	15	0 2	0·09	4·8
Malt culms	—	—	7 0†	1 10	5 10	43	2 7	1·38	16

* At Hull. † At Liverpool. ‖ At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of September and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 per ton. The food value per ton is therefore £9 per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N 11s 0d.; P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

MISCELLANEOUS NOTES

Stud Goat Scheme

WITH reference to the note under this heading, which appeared on page 670 of last month's (October) issue of this JOURNAL, the full results of last season's (1925-26) working of this scheme are now available, and show steady growth of interest in the effort to improve the milch stock of small-holders, cottagers and persons of similar position. Each stud goat, before acceptance for service, is examined by the Inspection Officer of the British Goat Society, which administers the Scheme and receives a grant from the Development Fund towards its expenses; also to provide premiums enabling stud goat owners to charge low service fees within the means of those for whose benefit the Scheme was devised.

During the past season 89 stud goats were registered at 83 centres, and the 1,115 services given show an increase of over 26 per cent. upon the previous season's figures, despite the restrictions due to Foot-and-Mouth Disease Regulations. The improvement may be attributed in some measure to the wide publicity obtained for the Scheme by means of notices and advertisements in the agricultural press; also to the circulation of the Society's pamphlet, giving a list of the approved stud goats, to its members, affiliated associations and the County Education Authorities.

An interesting development of the Scheme has been the offer, by certain members of the British Goat Society, of prizes for the best kids sired by registered stud goats. Several competitions for these have been held at local shows, the entries, of excellent quality, showing care and attention on the part of their breeders. It is estimated that 1,630 female kids have been reared as a result of the past two years' working of the Scheme.

The Agricultural Index Number

THE general index number of the prices of agricultural produce showed a sharp rise in September, advancing to 55 per cent. above pre-war as compared with 49 per cent. in August. This very appreciable increase was due to the rise of 4d. per gallon in the contract price of milk in the London and Birmingham areas, the average of the index numbers of all other commodities being lower on the month.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921 :—

Month	Percentage Increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	180	71	67	60	71	58
February	164	75	63	61	69	53
March	146	73	59	57	66	49
April	145	66	54	53	59	52
May	115	69	54	57	57	50
June	105	64	49	56	53	48
July	103	67	50	53	49	48
August	122	68	52	57	54	49
September	113	59	52	61	55	55
October	82	61	50	66	53	—
November	74	63	51	66	54	—
December	71	61	55	65	54	—

Live Stock

Prices of most classes of live stock showed little change from those ruling in August. Fat cattle, however, became cheaper and averaged 1s. 10d. per live cwt. less on the month, the index number declining by 4 points to only 39 per cent. above 1911-13. As compared with September last year fat cattle sold at a reduction of 4s. 8d. per live cwt. Fat sheep again averaged 11d. per lb. estimated dressed carcass weight, the index figure being unchanged at 52 per cent. above pre-war. Fat pigs remained dear, baconers being unchanged both in price and index number, but the advance of 2d. per stone in porkers was relatively less than in the base years and the index number fell by 2 points. Fat sheep were 1½d. per lb. cheaper than in September, 1925, but bacon pigs were 11d. and porkers 1s. 3d. per stone dearer on the year.

Dairy cattle appreciated by about 15s. per head on the month, the index number rising from 37 to 39 per cent. over pre-war, but they were considerably cheaper than in September, 1925. Store cattle were cheaper on the month and realised only 28 per cent. higher prices than in 1911-13. Store sheep were unchanged at 63 per cent. above pre-war, but were about 15 per cent. cheaper than a year ago. Prices of store pigs hardened a little during September and were 142 per cent. above 1911-13.

Grain

As is usual in September prices of wheat and oats declined while those of barley increased. Wheat averaged 2s. 3d. per cwt. less than in August and the index figure dropped from

69 to 50 per cent. above pre-war, a reduction of 19 points as compared with increases of 2 points and 6 points respectively in the corresponding months of 1924 and 1925. Oats showed a reduction of 11d. per cwt. and the index number declined by 8 points to only 25 per cent. above 1911-13. The increase of 1s. per cwt. in the average price of barley was proportionately smaller than in the basic period, so that the index figure receded from 52 to 50 per cent. above the basic years. Average prices in September were 11s. 3d. per cwt. for wheat, 12s. 6d. per cwt. for barley and 8s. 5d. per cwt. for oats, wheat being only 3d. per cwt. less than in September, 1925, but barley was 1s. 7d. and oats 1s. 3d. per cwt. cheaper on the year.

Dairy and Poultry Produce

The agreement negotiated last autumn by the Permanent Joint Milk Committee representing producers and distributors provided for the contract price of milk to be raised to 1s. 4d. per gallon in September, 1926, whereas in September, 1925, the contract price remained at 1s. per gallon as in the summer months. This rise in price caused the index figure for September to show a rise of 40 points, milk prices in September being exactly double the pre-war summer level. The price of butter showed an increase of ¾d. per lb. on the month, the rise being in the same proportion as in the base years, so that the index number remained unchanged at 56 per cent. above pre-war. Cheese, however, declined by 1s. 6d. per cwt., the index figure falling from 43 to 34 per cent. above 1911-13. Both butter and cheese were cheaper than in September, 1925, the former by 2d. per lb. and the latter by £1 11s. per cwt. The rise of 2d. per dozen in egg prices as compared with August caused the index figure to advance by 3 points to 52 per cent. above pre-war. Eggs also were cheaper than in September, 1925, the decrease being 3½d. per dozen.

Other Commodities

Prices of potatoes were relatively improved during September, the average wholesale prices being 40 per cent. above pre-war, as compared with only 11 per cent. in August, but they were about 10s. per cwt. lower than a year earlier. The trade in hay remains very quiet and values have not varied. Although fruit and vegetables are not now taken into account in calculating the general index figure for all agricultural produce, it may be mentioned that apples sold during September at more than double the pre-war price, but pears and plums realised very little more than in September, 1911-13. Vegetables

generally were much cheaper on the month and cabbage and cauliflowers sold at lower prices than in September, 1911-13. Celery averaged 31 per cent. and carrots 42 per cent. above pre-war.

Index numbers of different commodities during recent months and in September, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	Sept.	Sept.	June	July	Aug.	Sept.
Wheat	61	53	71	73	69	50
Barley	107	69	21	17	52	50
Oats	38	43	31	33	33	25
Fat cattle	54	53	40	40	43	39
Fat sheep	100	69	66	59	52	52
Bacon pigs	38	66	87	83	79	79
Pork pigs	37	65	90	84	83	81
Dairy cows	59	46	38	38	37	39
Store cattle	44	37	28	33	33	28
Store sheep	130	90	71	82	63	63
Store pigs	29	75	134	139	139	142
Eggs	71	75	26	33	49	52
Poultry	75	58	70	52	55	46
Milk	58	63	60	60	60	100
Butter	72	70	54	56	56	56
Cheese	42	77	80	78	43	34
Potatoes	99	53	−5*	21	11	40
Hay	1	4	9	8	11	9
Wool	105	40	25	23	24	31

* Decrease.

Farm Workers' Minimum Wages.—Meetings of the Agricultural Wages Board were held on September 21 and October 4 at 7, Whitehall Place, S.W. 1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions :—

Gloucestershire.—An Order to come into operation on October 12, 1926, when the existing rates are due to expire, fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to continue in force until October 8, 1927. The minimum rates for workers of twenty-one years and over are in the case of workers employed wholly or mainly as head carters 34s. 6d. per week of fifty-eight hours in summer (first Monday in March to last Sunday in October) and 36s. per week of sixty hours in winter (remainder of the year); head shepherds or head stockmen, 36s. per week of sixty hours all the year round; under carters, 32s. 6d. per week of fifty-four hours in summer and 34s. 6d. per week of fifty-seven hours in winter; under shepherds or under stockmen, 34s. 6d. per week of fifty-seven hours all the year round; other male

workers, 30s. per week of fifty hours in summer and forty-eight hours in winter (instead of fifty hours all the year round as at present). Overtime in the case of all classes of male workers is payable at 9d. per hour on weekdays and 11d. per hour on Sundays. The minimum rate in the case of female workers, irrespective of age, is 5d. per hour for all time worked.

Hampshire and Isle of Wight.—An Order to come into operation on October 12 continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until October 11, 1927. The rates are in the case of male workers of twenty-one years of age and over 30s. per week of fifty-one hours in summer and forty-eight hours in winter, with overtime at 8d. per hour except in the case of carters, cowmen, shepherds, and milkers for overtime employment on ordinary routine work of such workers, when the rate is 7½d. per hour. In the case of female workers of eighteen years of age and over the minimum rate is 5d. per hour for all time worked.

Lincolnshire (Parts of Holland).—An Order to come into operation on October 31 continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until October 29, 1927. The minimum rates in the case of male workers of twenty-one years of age and over are 35s. per week of forty-eight hours from October 31, 1926, to April 3, 1927, and of fifty hours from April 4, 1927, to October 29, 1927, with an addition in the case of cattlemen and shepherds of 6s. per week and in the case of horsemen 10s. per week to cover employment in excess of those hours. Shepherds are also entitled to certain sums by way of lambing money. The overtime rates for male workers are 10½d. per hour on Saturday, 1s. 1½d. per hour on Sunday, and 9d. per hour on any other day. Female workers of fifteen years of age and over are entitled to a minimum rate of 6d. per hour for all time worked.

Northamptonshire and Soke of Peterborough.—An Order to come into operation on October 26 continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until further notice. The minimum rate in the case of male workers of twenty-one years of age and over is 30s. per week of fifty hours in summer (first Monday in March to the last Sunday in October) and forty-eight hours in winter (remainder of the year), with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays. The minimum rate in the case of female workers of eighteen years of age and over is 6d. per hour for all time worked.

Oxfordshire.—An Order to come into operation on October 31, continuing until April 30, 1927, the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers. The rates are for male workers of twenty-one years and over 30s. per week of fifty hours in summer (first Monday in March to last Saturday in October) and forty-eight hours in winter (remainder of the year), with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays. The minimum rate in the case of female workers of eighteen years of age and over is 6d. per hour for all time worked.

Somerset.—An Order to come into operation on October 2, when the existing rates are due to expire, fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to continue in force until March 31, 1927. The minimum rates are in the case of male workers of twenty-one years of age and over 32s. per week of fifty hours (instead of fifty-two hours as at present), with overtime at 9d. per hour,

and in the case of female workers of twenty-one years of age and over 6d. per hour for all time worked.

Sussex.—An Order to come into operation on November 1 fixing minimum and overtime rates of wages for male and female workers to continue in force until further notice. The minimum rates for male workers of twenty-one years of age and over are in the case of horsemen, cowmen, stockmen, and shepherds 36s. per week of fifty-eight hours (instead of 35s. as at present), and for other workers 31s. per week of fifty-two hours in summer (first Monday in March to last Sunday in October) and forty-eight hours in winter (remainder of the year), with overtime in each case at 9d. per hour on weekdays and 10½d. per hour on Sunday. In the case of female workers of eighteen years of age and over the minimum rate is 5d. per hour, with overtime at 6½d. per hour on weekdays and 7½d. per hour on Sunday.

Wiltshire.—An Order to come into operation on October 12 continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until October 11, 1927. The minimum rates are in the case of male workers of twenty-one years of age and over 30s. per week of fifty hours, with overtime at 8d. per hour, and in the case of female workers of eighteen years of age and over 5d. per hour for all time worked.

Yorkshire (East Riding).—An Order to come into operation on November 24 continuing (with some minor amendments) the existing minimum and overtime rates of wages for male and female workers until November 23, 1927. The minimum rates are for male workers of twenty-one years of age and over who are not boarded and lodged by their employer, 35s. per week of fifty-two and a-half hours in summer (first Monday in March to last Saturday in October) and forty-eight hours in winter (remainder of the year) (subject to variation with the cost of living); and for male workers who are boarded and lodged, irrespective of age, foremen, 32s. per week or £81 12s. per year; beastmen and shepherds, 29s. per week or £73 19s. per year; waggoners, 28s. per week or £71 8s. per year, with lesser rates for lads and beginners, these rates being payable in respect of a week of fifty-two and a-half hours in summer and forty-eight hours in winter, with, in addition, twelve hours per week on weekdays and three hours on Sunday in attendance on cattle and horses. Male workers of twenty-one years and over are entitled to overtime at not less than 10d. per hour on weekdays and 1s. per hour on Sunday. The minimum rate for female workers of sixteen years and over is 5d. per hour, with overtime at 7½d. per hour.

Pembroke and Cardigan.—An Order to come into operation on October 1 continuing the existing minimum and overtime rates of wages for male and female workers until September 30, 1927. The minimum rates are in the case of male workers of twenty-one years of age and over 31s. per week of fifty hours in winter and fifty-four hours in summer, with overtime at 8½d. per hour on weekdays and 9½d. per hour for the first three hours of overtime employment on Sundays and 11d. per hour for all subsequent hours. In the case of female workers of eighteen years of age and over the minimum rates are 5d. per hour for a day of eight hours, with overtime on weekdays at 6d. per hour, and on Sundays at 6½d. per hour for the first three hours and 7½d. per hour afterwards.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

Enforcement of Minimum Rates of Wages.—During the month ending October 15 legal proceedings were instituted against ten employers for failure to pay the minimum and overtime rate of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture. Particulars of the cases are as follows :—

County	Court	Fines £ s. d.	Costs £ s. d.	Arrears of wages ordered to be paid £ s. d.	No. of workers concerned
Anglesey ..	Amlwch ..	—	—	—	2
Glamorgan .	St. Nicholas ..	1 2 0	—	1 10 0	2
Flint ..	Connah's Quay .	—	0 6 0	19 0 0	2
Suffolk ..	Halesworth ..	0 8 0	–	To be agreed	1
Carnarvon ..	Carnarvon County	2 0 0	0 6 0	16 15 4	2
Somerset ..	Temple Cloud ..	2 0 0	1 6 0	14 0 0	2
" ..	" ..	6 0 0	3 18 0	30 0 0	2
Worcs. ..	Upton-on-Severn	0 10 0	3 3 0	10 15 6	1
Somerset ..	Taunton ..	—	5 5 0	24 8 2	3
Yorks, W.R.	Tadcaster ..	—	1 19 0	34 7 0	3

The proceedings at Amlwch resulted in the case being dismissed, the Bench finding that one of the workers was a general worker and not a horseman. In the case of the other worker, the Bench took into consideration certain benefits, which had not been defined by the Anglesey and Carnarvon Agricultural Wages Committee as benefits which could be reckoned as part payment of minimum rates of wages, in view of the fact that the relevant Order did not prohibit the reckoning of such benefits.

In regard to the case heard at Halesworth (Suffolk), in which the Ministry brought proceedings in respect of further employees of a farmer who was prosecuted in August at Saxmundham, the Ministry contended that the worker, who performed forty-eight hours' work per week in summer spread equally over the six weekdays, was entitled to the full weekly minimum rate of 29s. 2d. and, in addition, overtime rates in respect of Saturday afternoon, since there was an implied agreement between the employer and worker for the worker to perform less than the hours (fifty per week excluding overtime) in respect of which the weekly minimum rate was laid down. The Bench convicted in the case of the first worker concerned, and the defence thereupon asked for the remaining cases to be adjourned pending an appeal.

Agricultural Research Scholarships.—The following awards of Research Scholarships tenable in the academic year 1926-27 have been made by the Ministry on the recommendation of the Development Commissioners' Advisory Committee on Agricultural Science :—

Name	Subject of Study
F. Crowther (London)	Plant Physiology.
R. E. Evans (Aberystwyth) ..	Animal Nutrition.
L. A. Allen (Reading)	Dairy Bacteriology.
J. N. Pickard (Cambridge) ..	Animal Physiology.
G. V. Jacks (Oxford)	Soil Chemistry.
Miss D. C. D. Whetham (Cambridge)	Economics (Minor Scholarship).

Special Research Grants.—The following awards of special research grants for 1926-27 have been made by the Ministry on the recommendation of the Development Commissioners' Advisory Committee on Agricultural Science:—

(A) RENEWALS

Institution	Investigation	Investigator
Bangor ..	.. Liver Rot in Sheep ..	R. F. Montgomerie.
Bangor ..	.. Virus Disease of Potatoes	Dr. T. Whitehead.
Bristol ..	.. TarDistillate Spray Fluids	L. E. Smith.
East Malling	.. Raspberry Diseases ..	R. V. Harris.
Imperial College	.. Loose and Covered Smuts of Barley	S. Dickinson.
Reading ..	.. Labour Force Employed on Farms on Varying Soils	J. S. King.
Wye ..	.. Cherry Black Fly and Fruit Moth	Miss F. M. Wimshurst.

(B) NEW APPLICATIONS

Institution	Investigation	Investigator
Armstrong College	Loss of Sugar from Hay and Cereal Crops ..	Dr. W. Maw.
Bangor ..	.. Liver Fluke and its Host Snails	W. R. Wright.
Bangor ..	.. Stability of Phosphatic Dressings	G. Griffith.
Cambridge Botany School ..	.. Shab Disease of Lavender	C. R. Metcalf.
Cambridge Plant Breeding Inst...	Good and Bad Fields of Wheat	H. B. Cowell.
East Malling	.. Incidence and Control of Apple Scab	Miss A. M. Frampton.
Harper Adams	.. Egg Production Performance Records	F. J. Dudley.
Leeds ..	.. Publication of Paper on Strains of Actinomyces	——
Manchester	.. Slug Control	J. Wood.
Seale Hayne	.. Pig Feeding Trials ..	T. J. Shaw.

Agricultural Scholarships for Intending Agricultural Organizers, Lecturers, etc.—The following awards of agricultural scholarships for 1926-27 have been made by the Ministry on the recommendation of the Development Commissioners' Advisory Committee on Agricultural Science:—

Name	Subject of Study
T. L. Bywater (Bangor)	Animal Husbandry.
Miss O. J. Robison (Chelmsford) . ..	Dairy Husbandry.
J. G. Williams (Aberystwyth)	Economics.

Agricultural Returns.—The Ministry of Agriculture and Fisheries instituted proceedings under the Agricultural Returns Act, 1925, against an occupier of an agricultural holding at Longdon, Tewkesbury, for failing to make a return of the acreage of crops and number of live stock on his holding on June 4, 1926. The defendant was fined £3 and ordered to pay 23s. costs.

Foot-and-Mouth Disease.—Nineteen outbreaks of foot-and-mouth disease have been confirmed since the issue of the October number of the JOURNAL. Twelve of these outbreaks were confirmed in existing infected areas—two in Denbigh and ten in the Shrewsbury district. New centres of disease were also discovered at Southgate, Middlesex, and Wellingborough, Northants. In the former district two outbreaks have occurred and five outbreaks in the latter.

These outbreaks bring the total for the year to 190, involving 27 counties and the slaughter of 5,316 cattle, 11,007 sheep, 2,237 pigs, and 7 goats.

SELECTED CONTENTS OF PERIODICALS

Agriculture, General and Miscellaneous

A Note on the Cost of Mole-draining, *T. Lewis, V. Liversage,* and *A. D. Imper.* (Jour. Roy. Agric. Soc. England, vol. LXXXVI (1925), pp. 43-48 + 3 pl.) [63.14.]

Farm Institutes and their Work, *J. R. Bond.* (Jour. Roy. Agric. Soc. England, vol. LXXXVI (1925), pp. 89-98.) [374.9.]

Field Crops

Winter Forage Crops and their Place in the Scheme of Cropping, *W. G. R. Paterson.* (Trans. H. and Agric. Soc. Scotland, vol. XXXVIII (1926), pp. 106-119.) [63.33.]

A Study of the Sugar-Beet Position, *A. Bridges* and *R. N. Dixey.*

(1) History and Development of the Sugar-Beet Industry. (a) General; (b) In U.S.A.

(2) Discussion of the Probable Expansion in England and Wales.

(3) Some Factors Affecting Future Development: (a) Costs and Factory Efficiency; (b) Labour Situation; (c) Food Supplies for Stock.

(Jour. Roy. Agric. Soc. England, vol. LXXXVI (1925), pp. 59-89.) [63.3433.]

The Comparative Cost of Mangolds and Silage, *H. W. Kersey* and *C. S. Orwin.* (Jour. Roy. Agric. Soc. England, vol. LXXXVI (1925), pp. 48-59.) [63.332; 63.19832.]

The Ensilage of Sugar Beet Tops, *H. E. Woodman* and *A. Amos.* (Jour. Agric. Sci., XVI, 3 (July, 1926), pp. 406-415.) [63.19832.]

Fruit

Some Factors Influencing the Period of Blossoming of Apples and Plums, *R. G. Hatton* and *N. H. Grubb.* (Jour. Pomol. and Hort. Sci., v, 3 (July, 1926), pp. 210-215.) [63.41.]

Influence of Summer Rainfall and Previous Crop on Fruiting of Apples, *A. H. Lees.* (Jour. Pomol. and Hort. Sci., v, 3 (July, 1926), pp. 178-194.) [63.41.]

The Preserving Qualities of Different Varieties of Fruit. Canning and Bottling Trials: I. Raspberries and Gooseberries, *F. Hirst.* (Jour. Pomol. and Hort. Sci., v, 3 (July, 1926), pp. 216-221.) [63.41; 664.85.]

The Importance of Applied Biology in Modern Fruit Growing, *H. V. Taylor.* (Jour. Pomol. and Hort. Sci., v, 3 (July, 1926), pp. 170-177.) [63.2; 63.41.]

Plant Pests and Diseases

Observations on the Biology of *Tylenchus dipsaci* (Kuhn) Bastian, and on the Occurrence of Biologic Strains of the Nematode, *W. E. H. Hodson.* (Ann. App. Biol., XIII, 2 (May, 1926), pp. 219-228.) [63.27.]

Concerning "Fairy Rings" in Pastures, *J. S. Bayliss Elliott.* (Ann. App. Biol., XIII, 2 (May, 1926), pp. 277-288.) [63.24.]

Discussion of the "Fungicidal Action of Sulphur." (Ann. App. Biol., XIII, 2 (May, 1926), pp. 308-318.) [63.295.]

Tar Distillate Wash Trials in the Bristol Province, *A. H. Lees* and *L. N. Staniland.* (Long Ashton Agric. and Hortic. Research Stn. Rpt. 1925, pp. 77-82.) [63.295.]

Investigations on the Leaf Roll and Mosaic Diseases of the Potato, *P. A. Murphy* and *R. McKay.* (Jour. Dept. Lands and Agric. (Dublin), vol. XXVI (1926-27), No. 1, pp. 1-8 + 2 pl.) [63.23.]

Live Stock

The Suffolk Horse, *F. Smith.* (Jour. Roy. Agric. Soc. England, vol. LXXXVI (1925), pp. 8-29 + 3 pl.) [63.61.]

How to Start Pig-keeping (Open Air), *Gervaise Turnbull.* (Jour. Brit. Dairy Farmers' Ass., vol. XXXVIII (1926), pp. 19-23.) [63.64.]

On the Fertility of Stallions, *H. G. Sanders.* (Jour. Agric. Sci., XVI, 3 (July, 1926), pp. 466-491.) [612.]

Fertility in Southdown Sheep, *J. E. Nichols.* (Jour. Agric. Sci., XVI, 3 (July, 1926), pp. 365-375.) [612.]

Baby Beef Production, *J. A. Scott Watson.* (Trans. H. and Agric. Soc. Scotland, vol. XXXVIII (1926), pp. 76-87.) [63.62, 043.]

The Influence on Nutrition of Sunlight and Artificially Produced Ultra-Violet Rays, *J. B. Orr, J. M. Henderson* and *A. Crichton.* (Trans. H. and Agric. Soc. Scotland, vol. XXXVIII (1926), pp. 88-105.) [612.394.]

Dairying

Dairying in Northern Ireland, *G. S. Robertson.* (Jour. Brit. Dairy Farmers' Ass. vol XXXVIII (1926), pp. 24-33.) [63.7 (416).]

Comparison of Dairy Shorthorn and Welsh Black Cattle as Milk Producers; and Effect of Time of Calving on the Yield of Milk, *E. J. Roberts.* (Jour. Agric. Sci., XVI, 3 (July, 1926), pp. 416-424.) [63.62; 63.711.]

Silage Feeding Experiments with Dairy Cows, *A. W. Oldershaw.* (Jour. Roy. Agric. Soc. England, vol. LXXXVI (1925), pp. 112-128.) [63.711.]

Chamomile (Mayweed) and a Taint in Milk, *F. Proctor.* (Jour. Agric. Sci., XVI, 3 (July, 1926), pp. 443-450.) [63.259; 63.719.]

Feeding for Milk Production, *A. C. McCandlish.* (Trans. H. and Agric. Soc. Scotland, vol. XXXVIII (1926), pp. 55-75.) [63.711.]

Veterinary Science

Braxy, *S. H. Gaiger.* (Trans. H. and Agric. Soc. Scotland, vol. XXXVIII (1926), pp. 1-27.) [619.3.]

Poultry

Poultry on the Farm, *A. Kinross.* (Trans. H and Agric. Soc. Scotland, vol. XXXVIII (1926), pp. 120-150.) [63.65.]

Digestibility Trials with Poultry. (1) The Digestibility of English Wheats, with a note on the digestibility of fibre in Sussex ground oats, *E. T. Halnan.* (Jour. Agric. Sci., XVI, 3 (July, 1926), pp. 451-458.) [63.651, 043.]

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NOTES FOR THE MONTH

Report of the Warble Fly Committee

THE report of the Departmental Committee appointed by the Minister of Agriculture and Fisheries to consider and recommend possible ways and means of exterminating the warble fly pest has now been issued.*

The Committee state that, as a result of their necessarily prolonged inquiries and trials, much valuable information has been obtained. A detailed account of the Committee's experiments is prefaced by an interesting review of the life history and habits of the pest, which has caused losses in respect of warbled hides estimated, in the worst years, at from £400,000 to £500,000 per annum.

The fly deposits its eggs on cattle, mostly on the legs, during the months of May to August. In four or five days the maggots are hatched and enter the skin close to where the eggs are laid. After wandering through the animal's system the maggots reach the wall of the gullet about September to January, and after some months' residence in the gullet wall they continue their wanderings and appear under the skin on the back of the animal along either side of the spinal column, sometimes as early as November and December, but more frequently from January and February onwards. Here the insects feed on the fluid arising from the animal's inflamed flesh, and breathing through a hole bored through the animal's skin they become fully grown during the spring and work their way out through the breathing holes and fall to the ground. Here they undergo a change into the pupal stage and rest among the grass for five or six weeks before emerging from the puparium as a fly.

Referring to the widely-held view that one method of infection is by absorption of the eggs into the animal's system

* Obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C. 2, price 1s. 9d. net.

through the mouth when an animal licks its skin, the Committee state that it has been proved by experiment that this is not so, but that under natural conditions the animals by licking their skin dislodge or destroy the eggs rather than facilitate the entrance of the parasites into their bodies.

The experiments were designed to determine (*a*) methods of preventing the fly from laying its eggs on cattle, and (*b*) the effects of drugs, dressings and other means for destroying the larvæ in the body of the host.

In the first place the experiments confirmed the conclusion reached by observers in America, Europe and this country that the warble fly lays its eggs almost exclusively on the legs of the animal, occasionally on the sides, flanks, and hips, but never on the back. The results of the experiments designed to prevent egg-laying, although they show that some protection is afforded by the application of certain substances during the summer (egg-laying) season, were not definitely satisfactory. The warble fly lotion gave the best results, but even in this case the reduction in the number of warble maggots in the "treated" animals did not exceed 50 per cent.

In regard to the prevention of egg-laying, therefore, the Committee is unable to recommend a satisfactory method, but it is convinced that much greater possibilities of exterminating the warble pest are held out by the alternative method of destroying the maggots. Attempts to destroy the maggot during its early migrating stages by injecting drugs into the host produced negative results, and the Committee considers the most effective method is by destruction of the maggot during the months February to June, either by squeezing out the larvæ through the breathing holes as they become evident, or by the application of a destructive dressing by means of a syringe, cloth or sponge as explained in detail in the Report. The method of "squeezing out," however, involves great effort, inconvenience and frequent handling, but these objections do not apply to the same extent to the application of dressings. At least four dressings and probably five in a season at intervals of two to three weeks would be necessary. It is important that these should be applied so that the liquid penetrates through the breathing hole into the cavity of the warble and comes in contact with the maggot.

In the latter connexion the Committee recommends dressings of (1) tobacco powder and lime, provided that tobacco with a standard nicotine content be available so as to avoid the use of either too strong or too weak a dressing;

(2) derris root ; and (3) nicotine sulphate and lime, all of which preparations were tried with success in the course of the Committee's experiments.

(1) The first of these consists of 4 lb. of tobacco powder, 1 lb. of lime, and 1 gallon of water. The directions for making the wash are :—In a gallon of water mix 1 lb. of fresh lime. Add 4 lb. of the tobacco powder and allow the mixture to stand for twenty-four hours. Then strain through coarse muslin or sacking and apply to the backs of infected cattle with a cloth or brush.

(2) The Committee expresses the opinion that derris has an advantage over the tobacco dressing in that, being a powder, it is easily carried and ready to be mixed and applied immediately. The weakness of the tobacco treatment lies in the trouble and inconvenience of preparation and handling, the necessity for steeping the mixture in water for twenty-four hours, and the difficulty of transporting the prepared solution in bulk. Derris, and to a certain extent also nicotine sulphate, dressings do not present the same difficulties and on that account should make a stronger appeal to the stock-owner. There is not at the moment, however, any non-proprietary standardised form of derris root on the market, and in the circumstances the Committee feel that the exploitation of insecticides derived from derris root for the purpose of destroying warbles must be left to the firms interested in the production of insecticides.

(3) On the other hand, nicotine sulphate is now freely available in the form of a solution guaranteed to contain 40 per cent. of nicotine. The formula should be :—

Nicotine sulphate ..	2 fluid oz.
Calcium hydrate	1 lb.
Water	1 gallon

The nicotine should be measured out in one of the glass or celluloid measures sold by any chemist. It is best first to place the lime in the vessel, then to add the water gradually, stirring thoroughly so as to prevent the formation of lumps, and lastly to add the nicotine sulphate. The mixture is then ready for use, but it will not retain its strength and should only be prepared when required.

Summarizing its conclusions, the Committee points out that the total extermination of warble flies is a harder undertaking than is generally thought, but that a few years' steady work on maggot destruction over any considerable area would do much to reduce the warble population to the verge of

extermination provided the sources of introduction were closed.

Discussing a suggestion that legislation should be introduced, the Committee expresses the view that no proposals for compulsory action on the lines of prevention—*i.e.*, prevention of egg-laying or destruction of eggs after deposit—warrant serious consideration. The Committee's experiments on this aspect of the question were not successful enough to justify such action, and compulsory treatment of all animals would be impracticable. In considering legislative measures in relation to the alternative method of treatment for maggot destruction, the Committee observes that, whilst such compulsory operations over a lengthy period would doubtless effect a considerable reduction in the number of larvæ and consequently of warble flies in succeeding years, the success of such measures in this country would be seriously prejudiced by constant importations of warble-infected cattle from overseas.

It should also be borne in mind that, except in the case of beasts so badly warbled as to be in poor condition generally, no differentiation is made in the markets between beasts which are warbled and those which are not. In the store-stock trade no notice of warbles whatever appears to be taken, while in the fat-stock trade prices are presumably fixed upon a basis which allows the butcher to discount losses due to warble-damaged hides and meat. Under existing conditions, therefore, the average farmer has no obvious inducement to deal with the warble pest; but he might, the Committee adds, be persuaded to make the attempt if it were clear that he would share in the resulting profits.

In conclusion the Committee suggests that opportunities exist for further investigation both by individuals and on commercial lines in the direction of adding to the entomological knowledge of the fly, and as to the measures available for controlling the warble flies and for preventing the laying of eggs.

Dairy Instructors' Conference, 1926

THE Third Annual Conference of County and College Dairy Instructors and Instructresses, convened by the Ministry, was held on October 21, during the London Dairy Show week, at the Central Hall, Westminster, under the chairmanship of Mr. J. F. Blackshaw, O.B.E., the Ministry's Dairy Commissioner. In addition to County and College

Instructors and Instructresses, there were present a number of Agricultural Organizers and Principals of Agricultural Colleges, together with representatives from Wales and Northern Ireland. Including the Ministry's Officers, the attendance reached 130.

The Conference was opened by the Minister of Agriculture and Fisheries, who was supported by the Parliamentary Secretary. Mr. Guinness referred to the considerable increase in the work of dairying instruction that had taken place recently. He pointed out that there was great scope for increased consumption of dairy produce in this country, and said, with regard to the grant of £40,000 per annum to be made to the Ministry by the Empire Marketing Board, that the Ministry hoped to be able to bring the dairying side of its work within the scope of the new activities which this grant would enable it to embark upon.

Addresses were given on the following subjects:—

"Advisory Work on the Rationing of Dairy Cows," by Mr. R. Boutflour, M.Sc., Director of Dairy Husbandry, Harper Adams Agricultural College.

"Instruction in Rural Elementary Schools," by Mr. F. Burkinshaw, Director of Education, Somerset, and Mr. J. O. Peet, O.B.E., H.M.I., Board of Education.

"Instruction to Young Persons Fourteen to Sixteen Years of Age," by Mr. P. G. Dallinger, O.B.E., B.A., Chief Inspector of the Ministry.

"The Bearing of the Milk and Dairies Order, 1926, on Clean Milk Production," by Dr. J. M. Hamill, O.B.E., Ministry of Health, and Mr. John T. Quinton, F.S.I.A., Sanitary Inspectors' Association.

"The Proposed International Dairy Congress, 1928," by the Rt. Hon. Lord Kenyon, K.C.V.O., Chairman of the Organizing Committee.

"Construction and Adaptation of Cowsheds," by Captain J. S. Lee, Superintending Architect of the Ministry.

"The Work of the National Milk Publicity Council," by Mr. A. D. Allen, O.B.E., Organizer of the Council.

All the addresses were followed by valuable open discussions. A most interesting discussion arose out of Mr. Boutflour's address, in which he stressed the importance of paying careful attention to cheapening the cost of milk production by efficient management of the dairy cow. In this connexion he referred to control of bulk in the maintenance ration, in order that the animal may make the most efficient use of the production ration. Dr. Hamill, in dealing with the Milk and Dairies Order, pointed out that, inasmuch as there existed an implied demand on the part of the public for a satisfactory product, the provisions of the Order would not only make for the welfare of the consumer, but would inevitably benefit

the milk trade itself. Mr. Allen, in outlining the work so far undertaken by the National Milk Publicity Council, said that the low consumption of milk in this country was largely due to ignorance regarding its value as a food. With regard to the contamination of milk, he thought that this was brought about in the home by the use of unclean vessels to a much greater extent than was generally realized.

The co-operation between the Ministries of Agriculture and Health and the Board of Education, and the consequent wider range of subjects dealt with, greatly increased the usefulness of the Conference.

Poultry Instructors' Conference, 1926

THE Fifth Annual Conference of County and College Poultry Instructors was held at the Ministry on October 19, under the chairmanship of the Poultry Commissioner. Seventy-four instructors, agricultural organizers, principals of colleges and others were present, including eight representatives from Welsh counties. Sir Francis Floud, Secretary to the Ministry, opened the proceedings with a brief address in which he said that poultry-keeping was a branch of agriculture with a great and increasingly prosperous future before it. He saw no reason why every farmer in the kingdom should not be able to pay his rent out of his poultry. Dr. C. Crowther followed with an outline of the aims and objects of the National Institute of Poultry Husbandry at Harper Adams College, of which he is temporary Director. He emphasized that the Institute was not a part of the College, but was national in character, and the educational and other facilities afforded at that institution were intended to be available for instructors and poultry-keepers throughout the country. Mr. Harry German, of the National Farmers' Union, gave an account of the activities of the County Poultry Committees recently formed by that body. In view of the fact that at least 80 per cent. of our home-produced egg supplies were derived from farms and smallholdings, the progress of these committees would be watched with interest. Mr. German referred to the difficulty experienced by poultry-keepers in buying reliable male birds, and urged that the Ministry should arrange for the supply of guaranteed cockerels from farms supervized by the Ministry. Dr. A. G. Ruston, Lecturer in Economics, Leeds University, read a stimulating paper on the "Costings of Poultry Farms," which dealt with the profits made by means of poultry-keeping on general farms in York-

shire, and aroused animated discussion. Mr. S. H. Lewer, President of the British Committee for the third World's Poultry Congress, described the arrangements which have been made for the British exhibit at the Congress at Ottawa next year. Mr. J. A. Caseby discussed the question of "Small Livestock Exhibits at Shows," a subject of which he has had considerable experience. Mr. T. Johnson, H.M.I., Board of Education, spoke on "Poultry Instruction in Rural Elementary Schools"; Dr. T. Milburn, Principal, Midland Agricultural and Dairy College, on "The Use of Lime for Poultry Runs"; Major C. H. Eden on "Egg-Laying Trials: Their Objects and Management"; Mr. F. Bowers, County Poultry Instructor for Essex, on the Egg and Chick Distribution Scheme in that county; Mr. C. A. Flatt dealt with the "Dressing of Table Poultry for Market"; while Mr. A. Thompson, County Poultry Instructor, Staffordshire, briefly reviewed "Methods of Poultry Trussing."

The Marketing of Dairy Produce

THE Imperial Economic Committee, appointed to consider the possibilities of improving the Marketing and Preparing for Market of Foodstuffs produced in the Overseas parts of the Empire, have now issued their Fourth Report,* which deals with dairy produce. The Committee regarded the supply of fresh milk and cream in the United Kingdom as a domestic problem, since the supplies are almost entirely in the United Kingdom itself, and their inquiry, therefore, was concentrated on butter and cheese. Margarine, which enters to some extent into competition with butter, forms the subject of a supplementary report annexed to the Fourth Report.

The inquiry was somewhat exhaustive and involved investigation into the trade in dairy produce, problems of production, the dairying industries of the Empire, manufacture and transport, marketing of dairy produce, consumption in the United Kingdom, research work and the dairy produce intelligence service.

The produce of dairy cows of the United Kingdom is sold mainly in the form of liquid milk, and thus large quantities of dairy produce are imported. Dairy produce, in fact, occupies third place among the main classes of foodstuffs imported, and

* Cmd. 2725. H.M. Stationery Office, price 1s. net.

in 1924 the value totalled £70,000,000. Of this amount butter and cheese imports represented £63,000,000, out of which no less than £33,000,000 (52 per cent.) was paid to Empire countries. The Committee state that the demand for liquid milk is likely to increase, and coupled with this, the fact that the consumption of butter and cheese is increasing, makes it evident that the market here for butter and cheese is expanding and likely to expand further. The demand for cheese in the United Kingdon is already met from within the Empire to the extent of 90 per cent., and the Committee's attention has, therefore, been largely concentrated on the question of butter supplies.

Whilst the Empire already supplies a considerable proportion of the consumption, there are indications that foreign countries are on the alert, and it is therefore considered likely that competition in the United Kingdom market will become more severe within the next few years, particularly from Argentina, Siberia and the Baltic States. This is the more likely, inasmuch as in the northern countries the rates of wages and standards of living are relatively low. The Committee's main conclusion, therefore, is that both at home and in the Overseas Dominions it will not be practicable to maintain present standards of living in the dairy industry unless the farming interests prepare to meet any cutting of prices by the adoption of more efficient and cheaper methods of production. Fortunately such improvement can be effected by means of an increase in output without seriously increasing costs: the quantity of milk and butter fat from each cow, and the number of cows supported on each acre can be increased. Cow testing (milk recording) for milk and butter fat is already practised on a small scale and should be applied generally throughout the Empire. A greatly increased output can also be obtained by attention to breeding and the improvement of pastures and garden crops; and it is suggested, *inter alia*, that the Committee's previous proposal for payments towards the transport of pedigree breeding stock from the Mother Country to the Dominions should be extended to cover stock for dairying as well as meat-producing herds.

Another matter of considerable importance is the distribution of supplies throughout the year. Owing to the distance, supplies from the southern Dominions do not reach the United Kingdom until the beginning of the year, whereas the northern supplies are marketed in greatest quantity during the spring or within three or four months after the arrival of the southern. Prices follow in sympathy and rise, of course, in the latter half

of the year, when the demand is met in part by the holding over in cold storage of excessive late winter and spring supplies. Butter is not improved by cold storage, and the Committee condemn the holding of butter in cold storage in the United Kingdom for a reserve price. One country, Denmark, has, by means of winter dairying, succeeded in regularizing her exports to the United Kingdom, and the Committee urge strongly that in all parts of the Empire the practicability of more winter dairying should be fully explored. Where it is impracticable and storage must be resorted to, to regularize supplies, the Committee recommend that the storage should be in the country of production, and only a small emergency supply stored in the United Kingdom. The Committee also reinforce the recommendation of the Linlithgow Committee and the Royal Commission on Food Prices that statistics of produce held in cold storage should be published.

Retail prices, especially of butter, have a far-reaching influence on consumption and thus indirectly on supply. Thus a quicker response of retail prices, especially at the end of the year when wholesale prices are falling owing to the arrival of stocks from Overseas, should result in a definite increase of consumption, with a lessening of opportunity for speculation and steadier returns to the Overseas producer. The Committee suggest that this more rapid adjustment of retail prices to available supplies lies very much within the power of multiple-shop companies and co-operative societies.

The Committee commend to the consideration of enterprise and capital within the home country, the scope which appears to exist for a great extension of the manufacture of ice cream as a foodstuff on a legally-defined basis.

On the subject of research the Committee state that there is no department of food supply in which there is greater scope for research than in dairying, for modern science is making very evident the special significance of dairy produce for the health of the community and especially for that of growing children. It is suggested that State-subsidized dairy research institutions, on the lines of those at Reading in England, and at Guelph and Ottawa in Canada, should be established in all the Dominions, and that there should be co-operation in the investigations carried out at these centres. Several specific subjects of research are dealt with in the report, most of them being regarded as suitable for financial assistance from the Empire Marketing Board.

In the supplementary report on margarine it is pointed

out that there is little difference in the fat and protein contents of margarine and butter, but that whilst the vitamin content is high in butter made from meadow-fed cows' milk it is almost negligible in margarine made from vegetables. Although, therefore, margarine is a useful food, it is inferior to butter, and especially so for growing children, but some modification in these statements may be made in respect of margarine containing a proportion of butter and other animal fats. The chief problem of margarine research, therefore, is the discovery of some palatable oil, rich in vitamins and suitable for mixture with the other ingredients, and the Committee recommend that funds be made available for research with a view to the conversion of fish oils and fats into an edible form. In general the Committee consider that attempts to introduce the cultivation of the soya bean within the Empire should be given all possible assistance and encouragement, with a view to increasing the acreage under this crop.

Wool Breeding Council

THE Secretary of State for Scotland and the Minister of Agriculture have recently appointed a Wool Breeding Council to consider and advise the two Departments on questions relating to the improvement and utilization of the wool grown in Great Britain. The Council consists of representatives of English, Welsh, and Scottish sheep breeders, the textile industry, and scientific investigators. Its chairman is Sir Robert Greig, and its secretary Mr. E. T. Smith, of the Board of Agriculture for Scotland.

The Secretary of State for Scotland has at the same time appointed a Committee to supervise research in wool breeding. The members of the Committee are Dr. Crew, Director, Animal Breeding Research Department, Edinburgh University; Sir Robert Greig; Mr. H. G. Richardson, of the Ministry of Agriculture; Prof. J. Lorrain Smith, of Edinburgh University; and Prof. R. G. White, of the University College of North Wales.

The Council and Committee have been appointed as a result of the further consideration by the Departments of the arrangements previously in operation under which certain breeding experiments were being carried out in this country, the object of which was to obtain an improvement in wool texture without diminishing the mutton value of the sheep.

A HEREDITARY LETHAL DEFORMITY IN NEW-BORN LAMBS

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DURING the last three years the writer has had the opportunity of investigating the occurrence of lambs which exhibit at birth a curious malformation of the limbs. This malformation almost invariably results in still-births, and in those rare cases where the lamb is born alive it dies within a very short period. In flocks where the defect occurs the loss may be serious, because the malformation makes labour so difficult that the ewe often perishes as well. The anatomical description of the condition is being undertaken by Professor Otto Mohr, of the Anatomical Institute, University of Oslo. The defect is clearly hereditary, and data are being accumulated which will make the exact mode of transmission known. Although this investigation cannot be completed for some time, it is thought that the present general description will be useful to sheep-breeders and others for a special reason. As will be explained below, both normal sheep-breeding practice and the mode of occurrence of the defect make it very easy for its existence to be overlooked, and it is possible that appreciable loss is being caused in certain flocks without the owners being aware of the fact. It is proposed, therefore, to give such a description of the defect as will enable sheep-breeders to recognize its occurrence, and it is hoped that those who do so will communicate with this Department* in order that sufficient knowledge may be accumulated to enable the defect to be eliminated. The condition is an example of the action of "lethal factors," of which some account will be given, and it should be realized that losses caused by the action of such factors are easily controlled by appropriate procedures of breeding.

The Nature of the Defect.—(*a*) The first sign that a ewe is about to produce a lamb exhibiting this deformity is "hydramnios," *i.e.*, a great accumulation of fluid in the envelopes which surround the lamb. This causes the sheep

* The Animal Breeding Research Department, University of Edinburgh.

to become much larger than she should be when compared with the normal pregnancy, and large quantities of fluid may be discharged before labour commences. The hydramnios will probably be noticed two or three days before the ewe lambs.

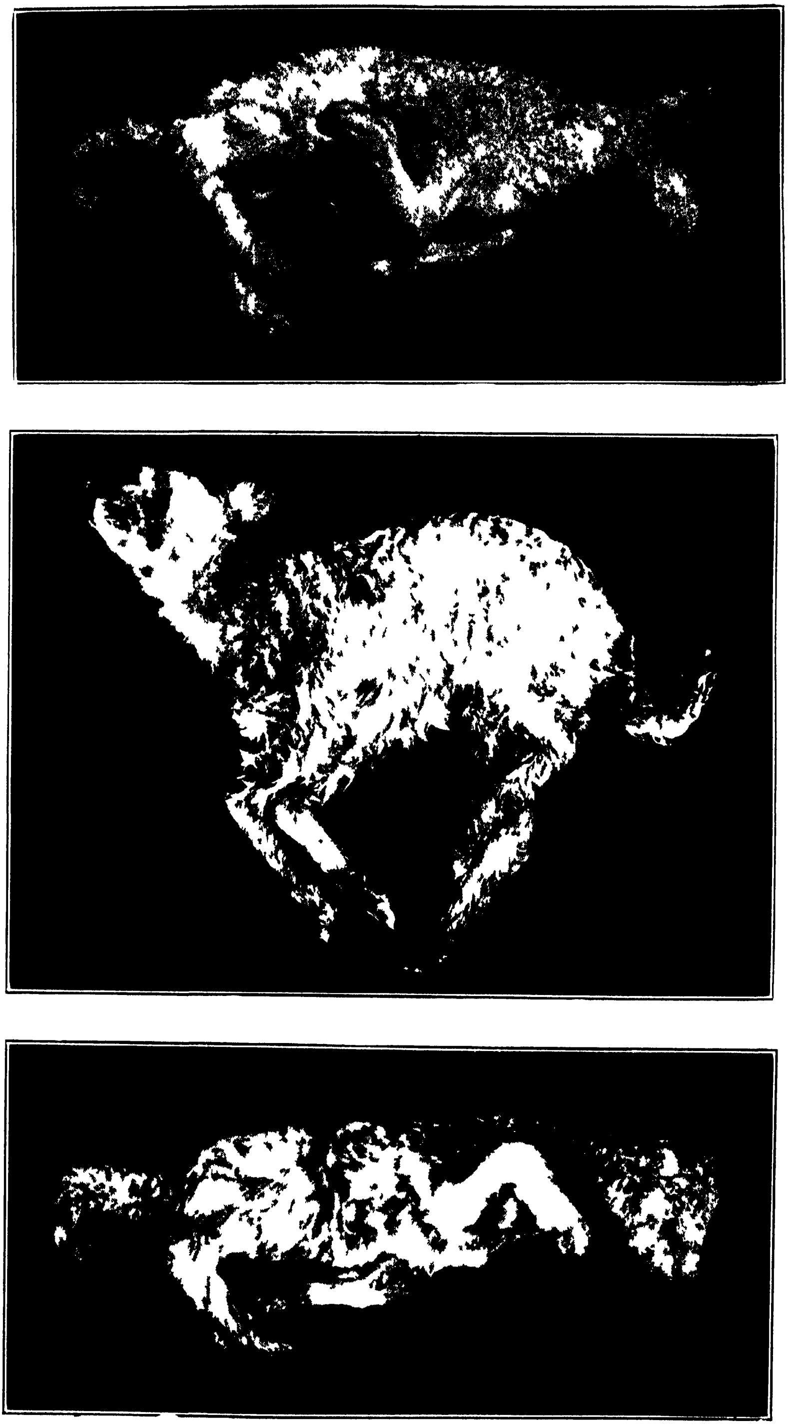
(*b*) When labour comes on, it is nearly always extremely difficult. In some cases the shepherd will find it impossible to extract the lamb at all, and frequently this will only be possible after the limbs have been removed. In a few cases the lamb can be extracted without very much difficulty or the ewe may even lamb without assistance, but in such cases it is usual to find that only the hind limbs of the lamb are affected, and this is exceptional.

(*c*) The lamb is nearly always dead when born. Out of forty cases investigated by the writer only one lamb was born alive, and it lived for three days. Without special experiment and observation, it is difficult to determine in any particular case whether the lamb is alive when labour starts and is killed during the course of labour or whether it has died previously. It is probable that in the majority of cases the lamb is already dead when labour starts, possibly dying at the time of the sudden increase of fluid, but that in some cases it is alive at that period and is killed during delivery. There is never any sign that death has occurred long before lambing, and birth is not premature.

(*d*) When the mother of a deformed lamb gives birth to twins, it will very rarely be found that both are affected. In nearly every case the co-twin is perfectly normal. This points definitely to the action of hereditary factors.

(*e*) Deformed lambs may be of either sex.

(*f*) The special feature of the deformity is that the limbs are perfectly rigid, so that it is impossible to bend them at the joints without breaking them. The fore-limbs are nearly always affected and may be fixed in almost any position; they may even be twisted round the back of the neck. Sometimes all four legs are affected, and in a few cases the hind limbs only. It is this rigidity of the limbs which makes delivery so difficult, especially that of the fore-limbs, because the hind ones, when affected, usually lie straight out in the normal position during birth, this being the reason why lambs in which the defect is confined to the hind limbs do not give much trouble in delivery. As an examination of the condition is being made by Professor Mohr, it is only proposed to give here such an account as will enable the condition to be recognized.



A Hereditary Lethal Deformity in New-born Lambs

[illegible]

It may be stated, however, that the rigidity of the legs may not be due to any malformation of the bones or joints, but may be of muscular origin.

Why the Defect may be Overlooked.—As far as the writer is aware, this deformity has not been previously described, and, as there are reasons for thinking that, while it may be rare, it is by no means extremely rare, it may be worth while considering some of the factors which cause it to be so easily overlooked.

(1) That veterinary surgeons should apparently not be acquainted with it is not surprising when it is remembered how seldom sheep are treated by them. Further, even if consulted, the surgeon would almost certainly proceed to cut up the lamb in order to deliver it, and the chance of recognizing the deformity after that process would be slight.

(2) Delivery is often impossible, and the proportion of cases in which the ewe has to be killed would certainly be greater if, as would usually be the case, the shepherd did not know to what the difficulty was due.

(3) If delivered, the limbs would often be torn off.

(4) Unless several cases occurred in the flock, and the shepherd were struck by the similarity, the cases would probably just be considered as ordinary still-births. Even if the rigidity of the limbs were noted, it might be ascribed to *rigor mortis*.

The Breeds Affected.—For some time the only cases that were encountered occurred in one particular flock of a Mountain breed. Recently, however, cases were discovered in other flocks widely distributed through the country. In spite of the small numbers found, four breeds were involved, two Mountain breeds, one Longwool, and one Down. There is every reason to assume, therefore, that the defect is not confined to a few breeds, but that it may be encountered in any breed.

The Inheritance of the Defect.—The studies that have been made so far indicate clearly that the condition is hereditary. This is shown by the fact that in nearly every case where the affected lamb is a twin the other twin is entirely normal. In the flock where the majority of cases have been observed, some forty during four seasons, it has been possible to work out the ancestry of the parents and thus obtain some information as to the method of transmission. Where an affected lamb is produced, the defect has been transmitted through

both parents, and, in fact, although the data are not yet sufficient for certainty in the matter, there is good reason to believe that the condition is the result of the operation of a single recessive Mendelian factor. The consequences of this mode of inheritance are that a sheep of either sex may bear a single dose of the factor, and, as it is recessive, such a sheep is normal. When two animals, both of which carry the factor, are mated, the expectation, on the average, will be one deformed lamb, which carries a double dose of the factor, in every four. Further, of those that are normal to all appearance, two out of every three on the average will carry the single dose of the factor producing the defect. If a "carrier" is mated to a normal sheep, half the progeny will also be carriers.

The lessons to be learned from these facts are sufficiently clear. Any sheep, ram or ewe, that is the parent of a deformed lamb should not be used for further breeding, and the normal offspring of such a pair known to have produced deformed lambs should also be eliminated, or, at least, should be discriminated against in culling as the chances are two to one in favour of any such sheep being a carrier. If in any flock the defect were to occur regularly and rams were used which did not sire any affected lambs, though ewes of the stock mated to them had previously done so, such rams could be assumed to be free, and it might be possible to continue their use for some time. The effect of this would be to decrease the number of carriers in the flock.

On the assumption that the defect depends upon a single recessive factor the highest proportion of affected lambs that could occur, even if every ram and every ewe were a carrier, would be 25 per cent. Normally the proportion would be far lower than this unless it so happened that some specially desirable individual or individuals that were carriers were chosen as the basis for line-breeding. In such a case the incidence of the defect might increase alarmingly and even approach the maximum 25 per cent. unless the position were realized and appropriate steps taken. Even a comparatively low percentage is a serious matter, however, in view of the difficulties attending labour and the resulting high rate of mortality amongst the ewes bearing these lambs. As stated above, it is probable that the mode of inheritance is of the simple type discussed, but even if further study should show that the matter is more complicated, the basic fact remains on which must depend any measure of control, *viz.*, that *both* parents are responsible.

Lethal Factors.—The case described is an excellent example of the operation of what are called "lethal factors." Such factors are hereditary Mendelian units which are transmitted according to known laws and which in certain combinations give rise to an animal so abnormal in structure or function that it cannot live. These factors may exert their influence at various periods during the life of the animal. They may act as in the present case by causing death about the time of birth. In other cases the animal may live for a short time and then inevitably die. On the other hand, lethal factors may cause death at various times between conception and birth, and there are strong reasons for supposing that a low fertility caused by abortion (abortion at a very early stage could not be recognized as such and would be described as barrenness) may often be due to the action of lethal factors. This is particularly the case in those instances where fertility is stated to have suffered as the result of inbreeding. The result of inbreeding is to produce strains that are relatively pure as regards their hereditary constitution. Lethal factors are necessarily recessive when simple in their action, and increasing genetic purity will unmask such factors by isolating strains including a large proportion of animals which carry the double and fatal dose. Semi-lethal factors must also be recognized. As the name indicates, the result of their action is not invariably fatal, but they act by shortening the duration of life, or by causing such derangement that the animals affected are peculiarly liable to die early.

It is certain that the operation of lethal and semi-lethal factors plays a large part in the breeding of farm animals, and is the source of considerable loss, and it is probable that further research will show that losses from this cause are greater than can yet be estimated. The control of losses due to this cause must be sought in appropriate breeding procedure. It is certainly far better to prevent the appearance of the deformed and unfit than attempt the difficult or often impossible task of subsequent cure, to say nothing of the fact that a cure, even if successful, will result in the multiplication of the undesirable type. The elucidation of a problem involving lethal factors is usually comparatively simple from a scientific point of view, and there is probably no field where the science of heredity can so rapidly and effectively bring material aid to the breeder of farm stock.

It may be useful to give a few examples of lethal factors and their mode of action. In cattle a very well-known case is

that of the so-called "bull-dog" calf occurring in certain breeds. (Crew, 1923.) A very similar condition has been described in the Norwegian Telemark breed by Wriedt (1925). It is probable that the occurrence of bull-dog calves is due to a simple recessive factor; a similar but not identical condition is known to occur in sheep. In the Friesian breed a condition has been described (Hadley, 1925) in which calves are born devoid of skin on the legs, ears, and mouth, and die within a few days or weeks of birth. This condition is again due to the action of a simple recessive factor. Detlefson and Yapp (1920) describe a case of congenital cataract in cattle that apparently also acts in the same way.

In horses an "eyeless" condition is known; it is definitely hereditary, and as the chances of survival of a blind foal are necessarily slight, it is fair to describe this as at least a semi-lethal. A similar defect is known to occur in other species of animals, including the sheep. Wriedt (1925) has described a genetic form of sterility in the Danish white horse, the result of the action of a lethal factor. Crew (1925) demonstrated two remarkable lethals in fowls. One is the Frizzle breed, in which the feathers are curled round to give the characteristic fuzzy appearance. Frizzles never breed true, but always give off-spring in the proportion two Frizzles, one plain-feathered, and one which dies in the shell. A single dose of the factor results in the frizzling, but the double dose is lethal and causes death in the shell. A factor, acting in precisely the same way, is responsible for the "Scots Dumpie." Dunn also describes a lethal factor in fowls the effect of which is to cause death at an early stage. Lethal factors are also known in dogs. One which occurs in the bull-dog and depends upon a recessive factor causes puppies to be born with a cleft palate. As they cannot suckle, they soon die (Wriedt, 1925).

It might be mentioned in conclusion that in *Drosophila melanogaster*, the fruit fly, about whose inheritance more is known than of that of any other animal, the number of

REFERENCES

Crew, F. A. E.: "The Significance of an Achondroplasia-like Condition met with in Cattle." *Proc. Roy. Soc.*, 1923, B, v. 95, pp. 228-255.

Crew, F. A. E. 1925. (Quoted by Wriedt.)

Detlefson, J., and Yapp, W. W.: "Congenital Cataract in Cattle." *Amer. Nat.*, 1920, v. 56, pp. 277-280.

Hadley, P. B.: "Inheritance of a Congenital Epithelial Defect of Calves." (Quoted by L. J. Cole.) *Proc. Scot. Cattle Breed. Conf.*, 1925, pp. 45, 46.

Wriedt, Ch.: "Letale Faktoren." *Zeit. f. Tierz.*, 1925, v. 3, pp. 223-230.

lethal factors that have been discovered is over forty; and there is no doubt that, with increasing knowledge of the heredity of farm animals, the wide distribution and importance of lethal and semi-lethal factors will become more evident, and, at the same time, there will emerge the knowledge that will lead to the control of the losses caused by them.

The writer wishes to express his thanks to Professor R. G. White, who was instrumental in securing nearly all the material that has been studied, and whose help and criticism have been most valuable.

POISONOUS PLANTS ON THE FARM

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AMONG the many wild plants of the farm are a considerable number which may prove seriously harmful and even deadly to live stock. Certain of them are weed pests in the ordinary sense of the term, but the harm they may do is immensely increased by reason of their poisonous properties. Some are implicated only to a slight extent, whereas others—fortunately fewer in number—speedily cause symptoms of poisoning and death if a comparatively small quantity be ingested. It is proposed here and in subsequent issues of this JOURNAL to give notes on some of the more poisonous British plants.

A number of points must be borne in mind when poisonous plants are under consideration. If an animal is found to be suddenly ill from some unknown cause the veterinary surgeon called in may suspect some form of poisoning. It is then desirable that an immediate search of the pasturage should be made, or it may be of the dried fodder and other feeding stuffs being used. It may be a case for a trained botanist, with a view to identification of any plant which may be poisonous. This is not all, as for poisoning to be caused it is necessary that the plant concerned shall be present in sufficient quantity to enable an animal to take enough to bring about immediate symptoms of poisoning; or alternatively that, in the case of some species, small quantities may be eaten for a continuous period, the poison being cumulative in the system until a stage is reached when the breakdown occurs and poisonous effects are manifested.

Animals seem to differ widely in the readiness with which they consume harmful and wild plants, some instinctively avoiding them. This is, of course, especially so when keep is plentiful or the harmful species is acrid or unpleasant to the taste or smell. It is, however, a surprising fact that some animals are liable to eat many things which are usually avoided. Chesnut and Wilcox, in the United States, found that "there seems to be no way of accounting for the appetite or taste of stock. This statement is perhaps especially true of sheep. We have often observed sheep eating greedily on one day plants which they could scarcely be persuaded to eat on the following day on the same range." In America also, horses have been known to acquire a depraved appetite for horse-tail.

Not only may heavy loss be caused by death or illness of stock, but poisonous symptoms are often accompanied by reduction of milk yield, or the milk is affected in a deleterious manner.

Matters are complicated by the fact that the same species is not necessarily equally poisonous in all districts, possibly owing to differences in soil and climatic conditions, nor at all seasons, probably because of differences in age. Another point is that all parts of a poisonous plant have not the same effect, some parts being more toxic than others. Again, whereas members of the buttercup family lose their poisonous properties when dried in the form of hay, others, *e.g.*, meadow saffron, are strongly poisonous both dried and in the green state.

Though the species of poisonous plants are not confined to grass land, the more readily determined cases of poisoning are likely to be those involving stock at pasture, if only because stock seldom have the opportunity of taking plants on arable land, except in so far as sheep are concerned. In ordinary pastures and meadows, along the dykes of water meadows, by hedgerows, under shady trees and alongside of woods, poisonous plants may often escape notice until the damage has been done. Cuttings of some plants, such as yew, laburnum, monkshood, hellebore, larkspur, may be thrown out with lawn mowings and trimmings from gardens, and in this way poisoning may occur. If keep is short, and animals are to some extent driven by hunger, they are more liable to eat whatever is luxuriant, green and succulent.

A point deserving of notice is that the different classes of livestock vary considerably in their susceptibility to poisonous

plants, while the individuality and age of the animals may involve greater or less effects. Generally the effects of plants on animals are widely divergent, but the writer has elsewhere defined a really poisonous plant as "one a small quantity of which when eaten induces some form of indisposition with irritant, narcotic or nervous symptoms, with serious or even fatal consequences either immediately or by reason of cumulative action of the toxic property."*

When it has been determined that a poisonous plant is present, there can be little question of the action which should be taken. Stock should be moved to fresh pasture until it has been possible to make the infested one safe for them by thorough removal and destruction of the harmful flora. In some cases this may involve cutting over and burning of the plants, but in others removal of the rootstocks may be very desirable or essential, as when certain perennial water-side weeds are involved. To be thorough, treatment must be followed up by repeated observation and regular removal of any fresh plants which appear.

There is also a legal aspect where poisonous plants are concerned, and this is deserving of consideration. The general principle of law is that a person who brings upon his own land any noxious or dangerous agent is bound at his own risk to keep it from injuring his neighbours. It is, therefore, unwise to plant or maintain poisonous trees or shrubs in boundary fences where they may overhang a neighbour's land.

Eradication of Poisonous Plants.—Poisonous plants on the farm are not confined to those which will commonly be found on the arable and grass land. They may in fact be: (1) Wild plants in the ordinary sense (*e.g.*, water dropwort, meadow saffron); (2) plants which are commonly grown in gardens and shrubberies for ornamental purposes (*e.g.*, yew, monkshood); or (3) feeding stuffs which may occasionally contain injurious ingredients (such as ergot or corn cockle), or be in themselves poisonous (*e.g.*, "Java beans" or "Indian peas").

The two last classes are really the most easily dealt with, for in the case of (2) one can be careful to insist that no waste materials shall be carelessly made available to farm stock; and as regards (3) the purchaser can at least guard against financial loss by purchasing under guarantee as to quality and as to freedom from injurious constituents.

* *Plants Poisonous to Live Stock.* University Press, Cambridge, 8s. 6d. net.

There remain the plants covered by (1). These may be divided into Annuals, Biennials and Perennials, and be dealt with in accordance with their place in these groups.

Annuals.—In general annuals may be combated by various means: Simply cutting to prevent seeding; the prevention of the introduction of fresh seed from external sources; surface cultivation in suitable weather, especially from March to May and on corn land after harvest, to encourage the germination of seeds in the soil, for destruction of the seedlings as they grow; and regular cultural operations thereafter. In grass land annuals need regular mowing, at times which vary somewhat with the species, but usually between the beginning of May and the end of June.

Biennials.—In the wide sense biennials need to be tackled in much the same way as annuals, but, since the seeds of many of them germinate late enough in the year to escape early operations, they need perhaps rather closer watching in order that the over-wintering seedlings may be destroyed either in the autumn or in early spring. Often a single cutting of an individual plant suffices to destroy it, as in the case of annuals.

Perennials.—The chief difficulty is met with when we come to consider perennials. The chief fact to bear in mind is that even perennials, including those with a creeping rootstock, must ultimately die if they are sufficiently often cut off at the base. This plan leads to the gradual exhaustion of the reserves of food in the rootstock, some of them being used every time the plant needs to send up fresh shoots in an endeavour to produce stem, leaves, flowers, and seed. As examples, it is well known that the ubiquitous bracken and the creeping thistle are not difficult to destroy if regular cutting is persisted in—say, three cuttings annually for three years between June and September. In this connexion it may be noted that perennial weeds in grass land are more readily combated than those in arable land, for arable land crops, especially winter cereals, enable the weeds to get a longer period to establish themselves, in part because they are less readily observed and in part because after a certain period the crop must be left to complete its growth and ripen.

The general principles involved in combating weeds are given in the Ministry's Leaflet No. 112, while certain poisonous plants are also dealt with in separate leaflets.

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—Lesser Spearwort (*Ranunculus Flammula*
natural size

FIG. 2.—Celery-leaved Buttercup or Crowfoot
(*Ranunculus sceleratus* L.), natural size.

FIG 3.—Acrid Buttercup (*Ranunculus acer* L).

a Fruit, natural size and × 5; *a′* Fruit cluster × 2, *b* Seedling, early stage; *c* Seedling, second stage, *d* Well-grown seedling, *e* Flowering stem (*b*, *c*, *d*, *e*, all natural size)

It is proposed here and in subsequent issues of this JOURNAL to give notes on some of the more poisonous British plants.

BUTTERCUP FAMILY (*Ranunculaceæ*)

Quite a number of the buttercups and their near relatives of the same order must unfortunately be included in the list of our poisonous plants. Many of the buttercups themselves are either acrid, irritant or severely poisonous, the flowers being the most harmful parts, followed by the leaves and stems. The old belief that the quality or colour of butter is due to the buttercups in the pasture would seem to have no foundation in fact, and no doubt most stock keepers would agree that buttercups are commonly avoided by cattle. Not only are some parts of the plant more poisonous than others, but there are seasonal variations. It seems that in the spring, when the shoots are quite young, but little poison is present ; but this develops until it is greatest in quantity at the time the plant flowers, after which it decreases until the stems die down. The poisonous principle would appear to be uncertain, but the bitter juice is doubtless the cause of the acrid, burning and narcotic effects produced when these plants are eaten, leading to irritation of the mucous membrane and inflammation of the digestive system.

There is one important point which demands special notice, and that is that the poison, whatever its identity may be, is volatile, for buttercups are readily rendered harmless by drying or boiling. For this reason they are held to be of value as fodder when dried in hay, in which form they are readily eaten. Species which deserve particular mention are *Ranunculus Flammula*, *R. sceleratus* and *R. acer*.

The Lesser Spearwort (*Ranunculus Flammula* L.) occurs chiefly in wet situations, such as water meadows and damp, low-lying fields and marshes. It may be about a foot in height, and has long, narrow, pointed leaves, very different in form from those of the common buttercups of meadows. The flowers are yellow, about half an inch or less in diameter, and are found especially from June to August (Fig. 1). The fruits are in small globular heads. It is annual or perennial. Henslow states that it has often proved fatal to horses and cattle, as at the village of Gamlingay, in Cambridgeshire.

Celery-leaved Buttercup (*R. sceleratus* L.) is an upright annual buttercup which grows from one foot to two feet in height. It occurs in all kinds of wet places, such as ditches and ponds. The leaves are smooth, and divided into three irregular lobes,

while the flowers are quite small—only about one-fourth of an inch in diameter—with pale yellow petals and the sepals turned sharply back towards the hollow stem. The flowers give rise to dense oblong heads of fruits (Fig. 2). It flowers during the summer months. This species is one of the most noxious buttercups, and has been the frequent cause of poisoning of stock, especially cattle. In France it is sometimes named *Mort aux vaches* or *Herbe sardonique*. Cattle are stated to have died in consequence of its having been mixed with miscellaneous herbage as fodder.

The Acrid Buttercup (*R. acer* L.) is one of the commonest species in pastures and meadows, and is often termed upright or tall crowfoot. It is an upright, hairy perennial, with cylindrical flower stalks, fibrous rootstock, divided lobed leaves, and yellow flowers well opened to about three-fourths of an inch across (Fig. 3). It flowers for a long period —April to September—and occurs on most soils. Its simple fibrous root-stock serves to distinguish it from the bulbous buttercup (*R. bulbosus* L.), the base of the stem of which is bulb-like, and from the creeping buttercup (*R. repens* L.), which has extensive rooting runners. Cornevin says it is probably the acrid buttercup which causes most accidents, the flowers being the most dangerous parts, and then the stems and leaves; and according to Strasburger it has frequently been the cause of poisoning in cattle. The death of three young heifers and a cow due to this weed were recorded in the *Veterinary Journal* in 1919. It gives rise to intense inflammation of the digestive organs.

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RESEARCH AND THE LAND: A REVIEW

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THERE is truth no doubt in the adage that a farmer learns by farming and by testing the traditions of his predecessors, but this conviction is nowadays rather an article of faith than a verified proposition. New problems have arisen which tradition hardly touches, and new methods have been discovered to ignore which means stultification. Tradition has no contribution to make to the problem of foot-and-mouth disease, and how self-handicapped the breeder is who continues to experiment without understanding Mendelism! But there is no question of a choice between traditional lore and modern science: the problem is how much can we get of both. The farmer who

is not content to drift must hold fast that which is good and test all things. If anyone was unconverted by Mr. Wilkins's previous volume, *Agricultural Research and the Farmer*, let him read with an open mind this sequel, *Research and the Land*,* which is an account of recent progress in agricultural and horticultural science in the United Kingdom. It is impossible for any farmer to make a better investment of half a crown, for here is up-to-date information, lucidly and judiciously set forth, regarding all the well-known difficulties in the art and craft of agriculture. Whether it be sour soil or manuring, disease-resistance in cereals or the improvement of grass lands, animal nutrition or animal breeding, Mr. Wilkins tells us at least what is going on. It must be admitted at the outset that many of the practical problems discussed are unsolved, and it is part of the scientific soundness of the book that the limits of what has been securely established are never blurred, but clearly set forth. Moreover, as is emphasized in the prefatory note by the Minister of Agriculture, there is a gap between the laboratory result and the farmer's confirmation, which is not filled even by the experimental institute. The efforts of all the colleges and research stations "cannot be fully successful without the support of the farmers themselves, and support must rest on understanding." Let us, therefore, give some account of the scope of this timely book.

Mr. Wilkins starts with a very interesting and very difficult problem, "The Physics of the Soil," not less important than its chemistry. One of the fundamental factors is the colloidal coating—perhaps a network—around the very minute particles of the clay fraction of the soil. This coating consists of a complex mixture, which is partly inorganic, derived from the weathering of the clay, and partly organic, derived from the organic matter or humus which is present in greater or less amount in almost all soils. The old-fashioned farmer has always recognized the importance of the physics of the soil, though he never gave it a learned name, and he has always known that the hard work needed to make crumbly tilth was as essential as any chemicals, but what is now being shown is that a deeper knowledge of intricacies such as the colloidal films may have practical applications which lead to the production of a soil that is well-aerated, well-drained, of good texture, and with a

* *Research and the Land.* An Account of Recent Progress in Agricultural and Horticultural Science in the United Kingdom. By V. E. Wilkins, B.Sc., Assistant Principal, Ministry of Agriculture and Fisheries. London: H.M. Stationery Office, 1926. Pp. xiv + 388. Price, paper covers, 2s. 6d.; cloth bound, 3s. 6d.

good tilth. Yet one must not forget that no efforts to understand colloids will make up for lack of efforts to plough well.

The chief problem of soil-physics is to improve the medium in which the plants grow, securing as economically as possible the ideal texture and the ideal water supply throughout the season. The chief problem of soil-chemistry is to ensure that the plants get the best food consistent with economy. That this inquiry makes advances, everyone knows; but, as the prefatory note says, the more one knows the more there is to know. If the soil is "sour," put in lime to counteract the inhibiting acidity; but a soil with much lime may still be hungry for more, and another deficient in lime may do well because it is rich in "interchangeable bases"; and thus the problem deepens.

Another promising line of research is into the life of the soil. It is not metaphorical to speak of "the living earth," for it contains myriads of bacteria and protozoa, besides minute algæ and fungi, and larger visible creatures like threadworms and earthworms, insects and their larvæ. "Each of these five groups, in struggling for its existence within the soil, has its influence on the fate of the farmer's crop, and each must be studied, at first independently and then in its relation to the others." Thus the soil bacteria and the soil protozoa are hostile to one another, and fertility varies with the issue of the battle. Similarly, "the manure heap is a fertile breeding ground for bacteria, some of them useful, some harmful. The farmer wants to encourage the types that fix nitrogen for him, for they will work without pay, and are not limited to hours." Here the bacteriologist has something useful to say, and will soon have more.

As tŏ plant-breeding there is advance along many lines, not least in this that there is an increasing number of farmers who understand the Mendelian method—how, for instance, it is possible to combine in one variety several desirable qualities. "The agriculture of almost every district in the country bears, in some way or other, a silent testimony to the value of the work of the plant-breeding research centres."

Wheats are being improved as regard yield, resistance, straw, milling and baking qualities, and so on; and is it not interesting that the microscope has shown that only those kinds can be successfully crossed that have the same number of nuclear rods or chromosomes in their germ-cells? The progeny of those with different numbers of chromosomes will be extremely varied and often sterile. It is thus no hyperbole to say that

microscopic analysis helps towards better bread. Similarly there are new departures of promise at least in barley and oats; and it is not far-fetched to ask if the grains of oats brought from the altitudes of Mount Everest may not afford a new beginning for the farmer in exposed highlands in Britain.

Though much success has rewarded the breeding of potatoes, *e.g.*, strains immune to wart disease, there is still much to be done, and it is attended with peculiar difficulties such as the frequent sterility or seedlessness of many of the flowers—a defect that greatly limits the possibilities of propagation. But we must not go into this, or into the industrious research that is in progress in so many experimental stations in regard to turnips, leguminous plants, agricultural grasses, flax, hops, and fruits of many kinds. Perhaps it may be said that nothing startling has emerged, and that many of the inquiries are so inconclusive that practical counsel would be premature. We must admit, as Mr. Guinness says, that "agricultural research is a slow business; and its application to practice is equally slow." We are personally of opinion that big results would come oftener if more of the investigators were deeply grounded in "pure science," but it would be ungracious and ungrateful in the extreme to refuse to admire what this book displays so convincingly, the large volume of sound and practically valuable agricultural research that is at present in progress in Great Britain and Ireland. More power to their elbow, that is all!

We cannot pass from plants without calling attention to figure 10, which displays a series of broad beans, which have been reared in water-culture with varying quantities of boron, from nil upwards, and show a growth proportionate to the amount they have received. This is an instance of one of the greatest experiments in the history of science, which should be repeated every year in every school, for it shows dramatically the *import of nurture*.

It is a great advance that animal nutrition has passed from an empirical to a physiological basis. Thus, Prof. T. B. Wood has worked out a scientific rationing of stock which takes precise account (1) of the animal's capacity for utilizing food; (2) of what it needs in calories to keep it in good health; and (3) of what it should get in view of the breeder's particular object. Theoretically the rationing is beautifully simple; practically it bristles with difficulties. Complications immediately arise, such as that in regard to which the Rowett Institute at Aberdeen, under the directorship of Dr. J. B. Orr,

has done fine pioneering work—the importance of the mineral constituents of the food, both for positive health and in the avoidance of disease. Then there is the question of the influence of ultra-violet rays on the bodily activities and health of animals. Mr. Wilkins admits that the farmer may perhaps consider that the application of ultra-violet ray treatment to stock is not within the realm of practical politics. Yet irradiation may become more practicable as a plentiful supply of electricity becomes available, and then it can be tried on the growing pigs and the laying hens, as well as on the milk cows in winter. Moreover, if the ultra-violet rays are not as such available, experiments prove the wisdom of the old-fashioned appreciation of the sunlight.

The success of the animal breeder for many centuries past is evidenced by the number of fine domesticated races, and thus the modern progress in the science of heredity has made less practical difference than the possibilities of the new methods would lead us to expect. But that, as Mr. Wilkins says, is largely because "the craft is so far in advance of the science. The breeder has probably gone as far as it is possible to go by means of empirical methods. His further progress must wait on the scientist, and in the interval, genetical research, though often apparently academic, still has a practical application in three important directions. It may lead to the immediate improvement of smaller stock, such as poultry and rabbits ; it may help in solving some of the problems of the live-stock industry which are affected by the simpler laws of heredity ; and last, but not least, it serves to create in the younger generation a scientific outlook on breeding problems which is essential if, in later years, the industry is to benefit by the application of such laws of heredity as scientific investigation may be able to postulate." There can be no doubt that Mendelian theory enables the breeder to understand better what he is doing, and to advance towards a desired end not only more rapidly, but more surely. Already the geneticists have good counsel for the breeder who wishes high-grade laying hens—have they not attained to 350 eggs in the year ?—or sheep with a certain quality of fleece, or Sussex hens without yellow legs and skin, or rabbits of desirable weight and pattern, and so on through a list too long for our review.

On a different line, but of great importance, are the investigations, at Cambridge and Edinburgh, on the physiology of sex and reproduction. Thus, it has been shown that by using hormone extracts of the pituitary body and more safely

of the ovary of the cow, it is possible to control in some measure the period of pregnancy and the process of parturition. By using ovarian extract it is possible to induce a female animal to come on " heat," and thus to secure her service at the proper time. How suggestive, again, is the fact that if milk-secretion, say in rabbits, is induced before the normal time, the ovary is prevented from ripening eggs, and no " heat " period occurs. If it be induced later, but yet abnormally soon, the embryos are absorbed by the body-fluids of the mother. It seems clear that the milk-glands are using up some specific substance obtained from the blood which is necessary to the proper functioning of the ovary in egg-production. Another curious, yet important, inquiry concerns the length of life of discharged sperms, and the possibility of securing artificial insemination in difficult cases.

We should have liked to refer to the work being done in connection with pests and parasites and diseases, and there are all the problems of milk-production—but it will be understood that we have given no more than a few samples of the kind of work that is going on at present in this country. Over a hundred trained investigators are putting brains into the problems of agriculture in the wide sense, and wisdom is always justified of her children. For anyone, whether specialist farmer or generally interested citizen, who wishes to know what is going on, this competent and lucid book is available ; and we would strongly recommend it, not only for its own sake, but as a particularly fine illustration of the general thesis that " Science is for life."

EXPERIMENTS IN MANURING

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THE fact that a certain manure is found to suit a particular crop sometimes leads farmers to assume that the yield of the crop can be increased proportionately with the amount of the manure applied. The supposition is, of course, erroneous, it being well-known that a stage will be reached when the law of diminishing returns becomes operative, and an increase in the quantity of manure applied ceases to be remunerative. The point at which the additional manuring of a crop ceases to be economic is, naturally, of special interest and value ; and, with the object of assisting local farmers in this matter, some experiments were commenced last year in West Devon, mangolds being selected for this initial investigation.

Arrangement of the Trials.—The trials were carried out at the farm of Mr. P. Luce, Court Barton, Lamerton, near Tavistock, on eight plots, each a quarter of an acre in area, the soil being loam over freestone. In addition to the artificial manures, 10 tons of dung per acre were ploughed in. The mangolds, following oats. which, in turn, had followed ley oats, were sown on May 15, 1925, and were harvested on October 15, 1925. The artificial manures were applied immediately before sowing. Each of the eight plots was divided into four sections, each section on plots 1 to 7 receiving different quantities of nitrate of soda in the form of top dressings. Plot 8 was constituted the control plot in respect of top dressings, and received no nitrate of soda. Particulars of the manures and top dressings applied to the various plots, and the yield and cost of the manures on each section, are given in the accompanying table, all rates and costs being given at per acre.

Observations on Results.—Among the points of interest disclosed by the figures in the table the following may be noted.

Manurial.—Plots 5 and 6 show that the mineral phosphate and basic slag, respectively, were not so suitable as the other phosphate manure, but the addition of extra nitrogenous manures gave marked increases. Plot 4 demonstrated the need of potash on this soil, but here, again, the extra nitrogenous manure showed marked increases in yield. Section A of plot 7 had the manuring which is favoured locally. Comparing Section A on each of plots 1, 2 and 3, the extra nitrogenous manure applied to plot 3 at the time of sowing produced an increase, but further additions of nitrogen to this plot did not give so large an increase as on the other two plots. This fact will be carefully investigated in this year's experiments, it being possible that the climatic conditions last year may have had some bearing on the results. Comparing plots 1 and 2, the additional nitrogen has given most marked results on plot 2, which received very liberal dressings of phosphate and potash.

Yields and Costs.—Taking the manurial costs per acre with the weight of mangolds grown, the maximum economic outlay for manures on this particular soil appears to be reached in section C of plot 2. It would hardly be fair, however, to form a decision from the mangold crop alone, as the residue of the phosphate and potassic manures has to be allowed for. With the oat crop, which is following the mangolds, this will be taken into consideration and yields noted for each plot. Comparing the cost of manures on section C of plot 2 with that of

MANURIAL EXPERIMENTS WITH MANGOLDS, WEST DEVON, 1925. (Rates and Quantities at per acre.)

	Manures N.B.—Phosphatic Contents : Superphosphate : 30 per cent. Basic Slag : 40 ,, ,, Vitrolised Bones (total) : 32 ,, ,,		Section A — On Plots 1—7 only Nitrate of Soda : ½ cwt. at singling.			Section B — On Plots 1—7 only Nitrate of Soda : 1 cwt. at singling.			Section C — On Plots 1—7 only Nitrate of Soda : 1 cwt. at singling. 1 cwt. 45 days later			Section D — On Plots 1—7 only Nitrate of Soda : 1 cwt. at singling. 1 cwt. 45 days later 1 cwt. after further 21 days		
			Yield Ton	lb	Cost of Manures £ s d	Yield Ton	lb.	Cost of Manures £ s. d.	Yield Ton	lb.	Cost of Manures £ s. d.	Yield Ton	lb.	Cost of Manures £ s. d.
1	Sulphate of Ammonia : Superphosphate : Kainit :	1 cwt. 4 ,, 4 ,,	42	64	2 8 2	44	0	2 15 5	47	92	3 9 11	46	160	4 4 5
2	Sulphate of Ammonia : Superphosphate : Kainit :	2 ,, 8 ,, 8 ,,	43	96	4 9 1	54	64	4 16 4	58	64	5 10 11	59	96	6 5 4
3	Sulphate of Ammonia : Superphosphate : Kainit :	2 ,, 4 ,, 4 ,,	47	92	3 2 8	49	32	3 9 11	50	64	4 4 5	50	0	4 8 11
4	Sulphate of Ammonia : Superphosphate :	1 ,, 4 ,,	36	128	1 16 2	44	128	2 3 5	48	128	2 17 11	49	32	3 12 5
5	Sulphate of Ammonia : Kainit : Egyptian Mineral Phosphate ·	1 ,, 4 ,, 2 ,,	34	64	2 4 9	36	0	2 12 0	42	192	3 6 6	45	160	4 1 0
6	Sulphate of Ammonia : Kainit : Basic Slag :	1 ,, 4 ,, 337 lb	34	64	2 4 1	36	0	2 11 4	37	32	3 5 10	42	192	4 0 4
7	Sulphate of Ammonia : Superphosphate : Vitrolised Bones : Kainit :	1 cwt. 5 ,, 2½ ,, 188 lb.	39	96	3 6 8	40	0	3 13 11	45	0	2 8 5	47	0	5 2 11
8*	Sulphate of Ammonia : Superphosphate : Kainit :	1 cwt. 4 ,, 4 ,,	42	192	2 0 11	43	96	2 0 11	44	0	2 0 11	43	0	2 0 11

* Plot 8 was made the Control Plot in respect of top dressings and received no Nitrate of Soda.

plot 8, the extra mangolds on the former have been grown at a cost of about 5s. per ton, taking rent, rates and cost of labour for tillage operations as equal in each case.

Keeping Quality of the Crop.—Besides the yield per acre a point of interest to the practical man is the keeping quality of a mangold crop. Although heavy dressings of nitrogenous manures are not regarded as conducing to good keeping qualities, the roots from these plots kept well, including those from the more heavily dressed nitrogenous plots, which were stored separately. The inference drawn was that the phosphate and potash were applied in sufficient quantities to prevent undue forcing by the nitrogen.

Feeding Value: Percentage of Dry Matter.—Excessive quantities of nitrogenous manure are also considered to be detrimental to feeding quality, but the results of the chemical analyses of the roots grown in the experiments suggest that the amounts of phosphate and potash available for the crop on each plot were sufficient to ensure a normal growth. Roots from plot 8, which was not top dressed with nitrate of soda, gave 10·1 per cent. of dry matter, while plots 2a, 2d, 4a, 4d, 5a and 5d gave, respectively, 9·5, 9·8, 10·0, 10·1, 9·7 and 9·5 per cent. of dry matter. Even though no allowance is made for experimental error in the chemical analyses, these figures show satisfactory returns in the amount of dry matter produced per acre for the extra outlay in manure.

NOTE: A similar set of plots has been laid down this year on an adjoining field having the same type of soil.

METEOROLOGY AND AGRICULTURE

(*Concluded from page* 753).

THE following are brief summaries of the remaining papers read at the Second Conference, arranged by the Ministry, of workers engaged on the study of various aspects of the effect of weather on crop growth, which was held on September 30 and October 1, 1926. It is proposed to issue, later, a full report of the Conference, and a limited number of copies will probably be available for free distribution.

Solar Radiation (*Mr. R. Corless*).—One of the questions which arises in regard to solar radiation is whether the heat-radiation, in which meteorologists are mainly interested, and which is confined chiefly to the red and infra-red rays of the

spectrum, suffices for the requirements of the botanist. There is no definite information as to the extent of the band of wave-lengths which is important for plant growth ; but it is common knowledge that light, as well as heat, is vital for plants, and it may be that radiations of much shorter or much longer wave-length are also important for their development.

The intensity of solar radiation at the outer boundary of the atmosphere is approximately constant ; the variations in solar radiation which we experience are due almost entirely to the effect of the atmosphere (including clouds, haze, dust, etc.) in absorbing more or less of the energy stream. When the sun is in the zenith the length of the path of the radiation through the atmosphere has its minimum value. When it is on the horizon the length has its maximum value. In the latter case every layer of the atmosphere contributes an increased amount to the path of the rays, but the lower layers contribute much more in proportion than the uppermost layers. The lower layers contain the whole of the clouds, haze, dust and other foreign matter, all of which absorb radiation freely, and so we have the explanation of the low radiation in winter, and in the early morning and evening at all seasons. A growing crop on a level field receives only the vertical component of the radiation which falls on the field. If the field is not horizontal it can deal only with the component of the radiation at right angles to its surface. Hence in the case of the level field the effective intensity of solar radiation when the sun is low is considerably reduced below the value which represents the whole intensity of the radiation stream received.

The sunshine recorder, in general use at crop-weather stations, is not intended to give any measure of the total amount of solar radiation received : all that it purports to do is to record the duration of " bright sunshine." So far as the instrument is concerned bright sunshine experienced in the late afternoon of a frosty winter's day is equivalent to an equal duration of midday sun on a hot day in June or July. An instrument which gives a continuous record of the intensity of sky and solar radiation is the Callendar radiograph. Experiments with it have shown that radiation from clouds forms an appreciable part of what is recorded. The " greenhouse effect " of the glass bulb of the instrument is shown by the fact that outward radiation at night is not recorded, and is presumably not able to pass through the glass. At the other end of the spectrum, ultra-violet radiation, which is pronounced at midday, is also excluded. The selective absorption of the glass

is therefore a factor to be kept in mind. By replacing the glass bulb with quartz or other selected transparent materials it is possible to obtain records of the intensity of other wave-length bands. The Callendar radiograph measures the radiation of a certain band of the radiation which falls on a horizontal surface, and it is therefore likely to give records which can be compared with statistics of crop growth provided the frequency band recorded by the Callendar is similar to that which is of importance for crop growth. An examination of sunshine data and radiation data for corresponding periods of a week or longer reveals a decided relationship between the two ; it is only with an exceptionally dull or sunny week or month that there are striking discrepancies between the two sets of data. The similarity between the two sets of data does not, of course, extend to individual days.

The author could not state what effect on crop growth is exercised by the longer and shorter wave-length radiations, which are not transmitted by ordinary glass, and are, therefore, not recorded by the Callendar radiograph. Dr. Leonard Hill states that ultra-violet radiation has, in his opinion, little effect on plant life. However that may be, the ultra-violet radiation curve also follows the sunshine curve rather closely. Indeed, there seems to be good reason for stating that in all probability mean serial values of the vertical component of solar radiation, taken over consecutive periods of a week or a month or longer, and having regard to a wide band of wave-lengths of radiation likely to affect plant life, bear a fairly close resemblance to the corresponding curve showing mean aerial values of sunshine. The exceptional cases are either very sunny or very dull periods and are explained by the variations in the relative importance of the sky-shine contribution to the total radiation which are characteristic of such periods.

Solar Radiation and Plant Growth (*Prof. V. H. Blackman*).— The solar radiation reaching the earth is of course of the greatest biological importance. It is the sole source of energy available for food production by the green plant, and so is essential for the growth and fruiting of the crop. The question of the exact manner in which light affects plant growth is, however, a very difficult one which has not yet been fully elucidated.

We observe in the plant two main effects of light. The first and more direct is that on the process of carbon assimilation, where the light energy absorbed by the plant is used in food production ; the plant is here almost solely concerned with that

part of the solar radiation which is recognized by our eyes as light. The second and more complex effect, of which we know much less, is the so-called formative (morphogenic) effect of light, *i.e.*, the effect of light on the form and structure of the plant. The rays mostly concerned in this action are the blue-violet ones.

As regards the effect of various intensities of light on the form of the plant, it is well known that plants grown respectively in bright light and in shade have a very different form and structure, and the two can usually be distinguished at a glance. It will be remembered that Dr. Gregory (see summary of paper in last month's JOURNAL) found a negative correlation between relative leaf-growth and total radiation. In other words low light intensity, within limits, favours leaf growth, while high light intensity tends to retard it. We have practically no knowledge of quantitative relationships between this formative effect and the intensities of radiation. The problem is complicated by adaptation effects, for example, a plant exposed for some time to a given light intensity reacts differently from one newly exposed.

There have been a large number of observations on the action of solar radiation on the rate of food production by the plant. The earliest observations with any attempt at precision were those of Brown and Escombe about twenty years ago. These investigators worked with single leaves in chambers exposed to a current of air in ordinary sunlight. They measured the CO_2 absorbed by the leaf and, assuming that sugar was formed, they calculated the useful work done. By estimating also the energy used in evaporation of water and that used in warming the leaf, they determined the efficiency of the leaf. In one experiment with bright sunlight, using a sunflower leaf, they found that only 0·66 per cent. of the radiation falling on the leaf was used in assimilation, and of the radiation absorbed by the leaf only about 1 per cent. was used. A close examination of this work shows, however, that the precision is illusory. Apart from the crudity of some of the measurements, this result is found to hold for only a particular set of conditions: a particular light intensity, a particular concentration of the raw material of assimilation (*i.e.*, CO_2), a particular temperature, a particular concentration of chlorophyll in the leaf, etc. It was found, for example, that if the light intensity in the above experiment was reduced to 1/12th, the efficiency in relation to the light falling was over 4 per cent. It is a well known

fact that the efficiency of the assimilating machine goes up markedly with reduction of light intensity.

In particular the concentration of CO_2 has a most striking effect on the efficiency. In some experiments carried out last month at the Imperial College, with a given light intensity, the growth of cucumber plants was increased 85 per cent. in eleven days by raising the CO_2 concentration. Light of different wave-lengths also has very different effects. In some recent, very careful work of Warburg and Negelein, using high concentration of CO_2, a medium temperature and very weak light, the average efficiency was, for red light, 59 per cent. and, for blue light, 33·8 per cent. Then again different plants are "tuned" (using a word which merely hides our ignorance) to work efficiently at different intensities. Assimilation takes place in the light and respiration in the dark, and the "compensation point" between the two, where they are equal in amount, is different with different plants.

We see that the efficiency of the plant stated as an absolute number has no meaning, and that laboratory data from single leaves and from plants grown under artificial conditions are of very little value. The most satisfactory method is to treat the crop as a whole, and attempts have been made to calculate the efficiency of field crops in relation to solar radiation. The calorific value of the aerial and underground parts of the crop is determined by burning in a bomb calorimeter. The energy stored up in the crop at harvest time is thus determined; the solar radiation falling on a unit of soil area being also known, the efficiency of the crop can be estimated.

The following crop efficiency data are given by Putter :—

Spring sown wheat	2·8 per cent.
Rye	2·3 "

If the loss by respiration is taken into account, the percentages become 3·3 and 2·6 respectively. Red Clover appears to be the most efficient crop, for, when respiration is considered, the efficiency reaches 5·4 per cent. The figures of crop efficiency are higher than those which might have been expected from Brown and Escombe's results. These two authors, however, worked with single leaves through which the light passed once only, whereas in the crop growing under natural conditions, the light is more fully absorbed as it may pass through several leaves in succession.

These calculations are based on estimations by Hertsprung of the solar energy reaching the ground at Kiel. For the period March 22 to September 21, the radiation (of a wave-length less

than one metre) received per square metre is calculated as 285,400 calories (large), the radiation received during these six months being four-fifths of that received during the whole year. It is probable that differences of crop-yield of different varieties may be partly due to their different efficiencies in the utilization of solar radiation.

The Value of Co-ordination in Phenological Observations (*Mr. J. E. Clark*).—Doubtless man's earliest conscious attention to the weather would have regard to his bodily comfort. The hunter would soon realize its relation to the coming and going of his prey, especially in temperate regions. Then, too—and of yet greater import—he would watch how the weather affected the growth of plants and fruits used as food, realizing its association with their various stages. When he turned cultivator of the choicer kinds, keener weather observations became essential. Thus man gradually became a student of the seasonal influences on animal and vegetable life.

With writing began records of these associations. We may recall those of the Nile floods, going back thousands of years; of vintages for over a thousand years. Indeed, we are largely able, thanks to such records, to ascertain now the variation from year to year of the ancient weather conditions. As we shall see later, even for the latter half of the eighteenth century, observations upon animal and plant seasonal changes have provided a welcome confirmation of the unexpected difference of the average temperature of that period, relatively to later years. With the eighteenth century the necessary accuracy in the case of individual enthusiasts had reached the stage when their records deserved to rank as the "science of appearances"; that is, phenology.

Phenology is usually included as a special branch of practical meteorology. But our introductory remarks show that the subject transcends the normal purview of that science, since it could be also regarded as a special branch of biology or of agriculture and horticulture. For its object is to ascertain the real relationship between the subjects of all these sciences, in other words between life stages and climate, laying special stress upon the influence of the seasons. Briefly, therefore, we may accept the definition in *Whitney's Century Dictionary*: "the science treating of the influence of climate on the recurrence of the annual phenomena of animal and vegetable life."

The possible lines of investigation arising out of this definition are enormous. Practical work has in the main been concen-

trated in two directions—of botany and ornithology. In the former, choice has fallen upon the phases of budding, leafing, blooming, fruiting, autumn colouring and leaf-fall for a select series of flowering plants. In the latter, upon bird movements, especially in spring migration.

Phenology co-ordinated had taken firm root half a century ago, though lacking coherence and presentation of results in a common, tangible form. Earlier still we have the admirable isolated observers from whom we get a fair idea of phenological events in south-east England over a period of 190 years. Graphs from 1750 on, when fairly reliable temperature records begin, confirm in an interesting manner that the mean temperatures from then to the end of that century were abnormally low compared to later times.

The present Royal Meteorological Society Phenological Scheme, carried out at some 300 stations, is based on the blossoming of thirteen plants, six bird events and six of insects. Tables showing the variation from average of temperature, aggregate temperatures, rainfall and sunshine are included for comparison.

Except in the United States there is little co-ordinated observation outside Europe. In the States the chief organizer has been Dr. A. D. Hopkins, head of the Entomological Bureau of the Department of Agriculture, working mainly on its economic aspect. But the wider results are summed up in Supplement No. 9 of the *Monthly Weather Review* (1918), entitled "Phenological Events and Natural Law as Guides to Agricultural Research and Practice." One of his most striking early successes was in circumventing the ravages of the hessian fly by correlation of grain sowing with phenological events. More theoretical is his far-reaching "Bioclimatic Law," covering the American North Temperate Zone. Both he and we have found that, with slight modification, it appears to be transferable to our own continent. It runs: "Other conditions being equal the variation in the time of occurrence of a given periodical event in life activity in temperate North America is at the general average rate of four days to each degree of latitude, (each) 5° of longitude and (each) 400 feet of altitude; later northward, eastward and upwards in spring and early summer and the reverse in late summer and autumn.

The Ministry of Agriculture in connexion with its Crop Weather Scheme has instituted precision records of selected crops and flowering plants. (See summary of following paper by Mr. Roebuck.) These should give a basis of correlation

between the two series, incomparably more reliable than anything yet attempted.

In phenological work we possess a most valuable ally for transferring and applying from country to country discoveries of economic importance dependent on more intimate knowledge of growth stages. But this predicates much closer correlation in the methods in vogue in different countries. Neither the schedules nor the methods have much common basis, though each is excellent in its own field.

An attempt to make an advance has been made through three articles in *Nature*. These have met with a gratifying response practically from all over Europe except France, and also from more distant countries. To the three known centres, Holland, Belgium and Germany, nine more are now known, each with its networks of stations, some of long standing. More than ten schedules were available, upon which have been based a schedule of thirty-one plants, seven birds and five insects, with the hope that in each country at least ten to twenty would be suitable for inclusion in their respective schedules. If this is carried out, each centre working up its own results, then in some ten years' time we should be well placed for carrying out correlation on a basis vastly more satisfactory than is now possible. By then, also, we should be reaping the first fruits of the Ministry of Agriculture scheme.

The Value of Phenological Observations in Practical Agriculture (*Mr. A. Roebuck*).—Crops are at the mercy of the weather complex. Its effects determine the success or otherwise of a crop to a far greater extent than the sum total of the diverse operations performed by the cultivator. Since the effect of climate is so great it is all the more important that we should take fullest advantage of it by a proper arrangement of all farm operations. Soil conditions may operate at times in a contrary direction, for example, by preventing earlier access to the land; but with improving methods of tillage, and better and speedier implements, these difficulties may in time be overcome.

It is then most important to have plants at any time in the proper stage of growth to take fullest advantage of the weather. We are all aware of a sequence of seasonal changes in plants. We also know that the same physiological state (say flowering) takes place at different times of the year in different species. For example, the hazel has flowered and set fruit long before the petals of the dog rose appear. Throughout most of the year

some striking phenomenon (leafing, flowering, fruiting, etc.) is taking place. Can we, then, utilize a number of such observations on established native species and correlate these with appearances on our crop plants so that we can get maximum results from year to year?

All our cultivated plants and, with few exceptions, our native plants show a pronounced yearly periodicity due to the alternation of a period of active growth in summer with a period of winter rest. The duration of the dormant period may be extended by severe weather or may be shortened by a mild winter. It also varies in different plants. After a prolonged winter, once activity has started, it proceeds more rapidly than after a mild winter. All the factors which compose climate help to bring about this annual periodicity by influencing the physiological qualities of the plants. No single factor is responsible. Even if the temperature in February be higher than in March, the growth in March would still be more energetic than that of February.

Side by side with this periodicity in plants we have periodical farm practices such as ploughing, rolling, harrowing, seeding, planting, harvesting. These also are arranged to take fullest possible advantages of soil conditions brought about by climate. Considering sowing, there is an early time before which it is unsafe to sow. Then there is a later time after which it is virtually useless, and somewhere between these two dates there is probably a time for maximum benefits. Hopkins has designated these as the early and late theoretical limiting times and the optimum time. The same applies to other farm operations.

Every cultivator from time immemorial has instinctively gauged the earliness or lateness of the season by the growth exhibited in our native plants. The efforts of phenological workers culminated in Hopkins enunciating his bioclimatic law in America in 1918 (see summary of paper above). It is specially interesting to note that Continental, American and British workers have confirmed this law on quite different series of observations. While the bioclimatic law marks a very important step in the science, and while it is of great value for one or two operations on the farm, it is nevertheless much too limited in its application for our purpose. The law is for average conditions for approximately half a year, either the early season or the late season. The cultivator in England is concerned with much more detail. Take two places in different latitudes (altitudes or longitudes), there is a much bigger

difference between their seasons in January and February than there is in March and April, which again is bigger than in May or June. In other words, there is a catching up as the season of optimum vegetative activity approaches. Arnell has shown that, going northwards from Schonen, for each degree of latitude, vegetative activity is later 4·3 days in April, 2·3 days in May, 1·5 day in June and 0·5 day in July. In other words, because one place should sow oats a week later than another, it does not mean turnips should be sown a week later, but more likely two or three days. This emphasizes the need for having the observations spread over a long period by means of several observations on the same plant and several selected plants.

The appearance of a certain physiological state in a plant is not sudden in the same sense as a rise in temperature, but is often dependent on the climatic conditions several months previously and how those conditions have continued since then. The dates of these periodical phenomena in plants are accurate indices of the bioclimatic conditions at any place, since they are in response to all the factors which constitute climate. The best indices of climate must, therefore, be the plants themselves, especially perennials. To a far less extent, insects and birds also may be of use as indices of climate.

It would be of supreme importance if we could with certainty be able to point out plants which would accurately gauge the state of the season so that we could say—when such a plant is in flower, oats should be sown; or, when another is in fruit, swedes should be sown, etc. During many years of observation the writer has noticed that oats sown when the purple plum (*Prunus pissardi*) commences to flower have yielded well and been free from frit fly attack, the pest most feared by growers. The flowering of the elder (*Sambucus nigra*) has also coincided with seeding of swedes to obtain good crops. The best time for seeding of winter oats appears to be between the flowering of ivy (*Hedera helix*) and the ripening of holly berries (*Ilex aquifolium*).

The author has constructed curves of growth for oat varieties in 1925 and 1926 and also curves for emergence of frit flies. Six inches is taken as the critical height for the oat plant; if it reaches this height when the flies appear it is not likely to be attacked. The curves have been compared with the date of flowering of purple plum and the conclusion is drawn that oats should be sown by this date.

With a view to testing the possibility of using index plants in practice, a scheme of observations has recently been for-

mulated under the Ministry of Agriculture's Crop Weather Scheme. The idea is to place the plants in a garden surrounding, or side by side with, the plot containing the meteorological instruments. In all, twenty-four plants are to be used. They are perennial herbs and shrubs. Five observations are to be made on each species, namely, (1) date of first leafing ; (2) date of flowering ; (3) date when the fruit is ripe ; (4) date of leaf colour change ; (5) date when they are leafless. A study of the list of plants shows that, with the possible exception of December, there will be two or three striking phenomena showing each month of the year in one or other of these species. From these it should be possible to test the regularity of the series as a whole and the applicability of index plants to practical agriculture.

* * * * * *

PARSNIP CANKER

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Introduction.—Canker is a disease that attacks parsnip crops very severely in some seasons but hardly appears at all in others. During 1924-25, quite 80 per cent. of the late-lifted crops in the Melbourne district of Derbyshire were practically ruined by it, but two of the growers who then suffered heavily had no loss with their crops the following season, and a third was but little affected. The lifting season for parsnips, grown on a field scale, extends from November to February, and, ordinarily, the disease does not appear until late in this period, although, in a bad canker year, it may begin early in the autumn. If it is showing at Christmas, the January and February liftings are usually seriously affected.

Influence of Soils, Manures and Seasons.—Experienced growers incline to the belief that crops, grown on land where the subsoil is very retentive of moisture, are most subject to this disease ; also that its virulence is increased in seasons where periodic checks in growth are followed by good growing periods. Manure and lime have both been blamed for its occurrence, but addition or omission of either or both does not appear to make any difference in a " Canker " season. There is, however, some evidence to show that, with too-richly manured soils and those lacking in lime, the virulence of the disease is increased.* Certain fields are reputed to be singularly free from attacks

* A. D. Cotton : " Diseases of Parsnips." (*Kew Bulletin*, No. 1, 1918, p. 8.)

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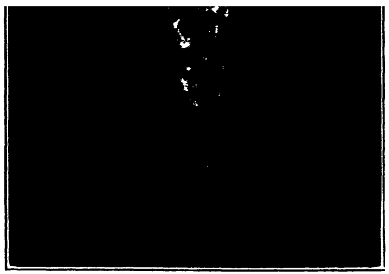

FIG. 1.—Parsnip Canker, showing Vertical Crack.

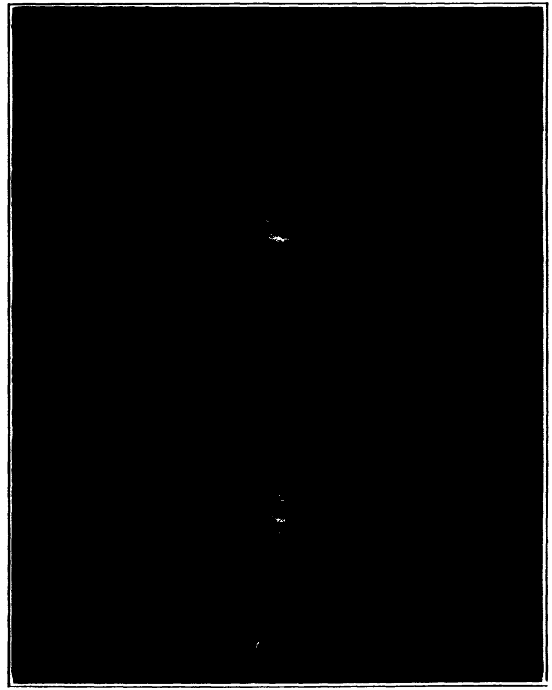

FIG. 2.—Parsnip Canker, showing Horizontal Cracks.

of the disease, and these have deep soils with loose, sandy subsoils. The intensity of the attack also appears to vary with the variety of parsnip grown.

Course of the Disease.—After growing for some time, cracks usually appear in the parsnip root; the skin is ruptured, apparently by sudden increased pressure from within, and the cortical tissues are then exposed. The cracks usually run horizontally and at or near the ground level, but they may take a more irregular course or even run vertically down the root. The skin comes off, exposing a rather rough edge and often taking with it a few layers of cells of the cortical tissue, this being rough where torn and exposed but quite clean and free from discoloration. Professor Priestley has shown that this exposed wound is not readily healed by the development of a corky protective layer as is the case with most other plants. It is thus laid bare to the attack of any micro-organisms, saprophytic or weakly-parasitic, and these may enter either before or after attacks by other pests.

With the entrance of the fungi and bacteria, a rotting commences, at first irregular, rather dry in appearance and of an orange-brown colour, but, later, becoming black and developing into a soft rot which destroys the whole of the shoulder and, finally, the whole root. Even when, as in some seasons, canker does not develop, there is often a blotchy, reddish-brown discoloration over the cracks, that is, apparently, normally produced by physiological processes in the plants. It does not seem, however, to detract from the market value of the roots.

Problem of Control.—In the prevention of cracking would appear to lie the best means of avoiding damage; and it seems reasonable to suppose that the primary cause of this cracking is the checking and subsequent restarting of growth in the plant. When cracking has taken place, the plant is unable to protect itself, and pests, fungi and bacteria, if favoured by the weather conditions, may then enter and produce the rot which destroys the root. The problem of preventing the cracking resolves itself, at present, into two lines of investigation:—

(1) The promotion of regular and uninterrupted growth, by providing a regular and continuous supply of moisture, with nutriment neither too great nor too little in quantity.

(2) The study of all varieties under cultivation to determine which, if any, are least liable to sudden checking and restarting in growth; which possess, in greater degree, the power to heal wounds by the formation of a protective corky layer; and which, also, possess commendable market qualities as to the size and shape of root.

Promoting Uninterrupted Growth.—Considering the first line of investigation, the problem resolves itself into management of the soil, the tilth, soil moisture and manuring. Experiments made in 1917* showed advantage in liming and also in salting. Both the lime and the salt operate in two ways; the lime by effecting an improvement in the tilth and by liberating nutriment, and the salt by liberating nutriment and by influencing the soil moisture. Kainit and potash salts may have similar effects which will be studied further, particularly as these and other substances may have some influence on the physiological processes in the root itself, such as improving its capacity for wound healing.

Resistance to Canker of Particular Varieties.—Observation of varieties during the past season (1925-26) in the Melbourne District of Derbyshire have given promising results, although the incidence of canker in this season was remarkably slight. To a certain extent, this may have been advantageous as, in the absence of the complicated rots following cracking, the susceptibility to cracking of the different varieties was more clearly observable. Ten varieties were sown, 21 yd. drill lengths of each being lifted from December 6 to 10, 1925, and a similar quantity on January 26, 1926. There was a marked difference in the amount of canker produced in the several varieties, but, in all cases, there was a progressive increase of the disease between the beginning of December and the end of January. The percentage of canker in December ranged from 0 to 10, but at the end of January it was from 12 to 50.

The varieties tried could be classified in three groups according to the degree of canker produced:—

(1) Slightly attacked (12-19 per cent.)—"Large Guernsey"; "Tender and True."

(2) Moderately attacked (26-34 per cent.)—Harrison's "Offenham"; Toogood's "Improved Marrow"; Finney's "Marrow Selected"; "Student"; Toogood's "Intermediate"; and "Hollow Crown."

(3) Severely attacked (48-50 per cent.) Elcombe's "Improved"; and Yates' "Evesham."

It should be noted that these results apply to one season only, but they seem to show that there is a definite connexion between the appearance of canker and the variety grown. It is possible, also, that the earlier-maturing varieties are more subject to the disease and it may be policy, therefore, for growers to cultivate more than one variety, leaving only the long season and more-resistant varieties for cropping after Christmas.

* *Kew Bulletin*, No 1, 1918.

SEEDS ACT, 1920

SEASON 1925-26

CHEAPNESS is too often the dominant consideration with the purchaser of seeds, to the exclusion of such important details as analytical purity, germination, trueness to strain, etc. The folly of buying solely on a price basis should be obvious when the comparatively insignificant cost of the seed is compared with the value of the land, the labour, and fertilizers used, and of the resulting crop. Price must, of course, be considered, especially under present conditions, but much the more important factor is quality. Recognition and consideration of the importance of quality is creating an advanced standard of judgment of seeds which cannot fail to be of the utmost value to agriculture. With so much at stake the farmer should consider carefully all the material particulars as to the quality of the seeds he buys, and he should always see that his seller supplies him with those particulars to which he has a statutory right under the Seeds Act.

The production, harvesting, cleaning, storing and distribution of good quality seed is a highly specialized business which can best be undertaken by those specially qualified to handle such a technical and expensive matter.

In spite of the obvious desirability of purchasing only high-quality seed many farmers still obtain their seed supplies from other farmers, in many cases without a test or any kind of guarantee as to quality. The position in this respect has, however, shown marked improvement during the past year or so. There is evidence that farmers are realizing more and more the value of obtaining full particulars of the seeds they purchase. This tendency is particularly noticeable among the younger farmers, whose influence it is hoped will gradually tend to bring the selling farmers into line with the seedsmen as regards supplying the necessary particulars with the seed they sell.

The Ministry is sometimes criticized for the attention it gives to the proper carrying out of the Seeds Regulations by seedsmen, when, at the same time, quantities of seed are being sold from farmer to farmer without a test. It is perhaps not realized how difficult it is to tackle this problem of farmer to farmer sales. A great amount of energy and time has been devoted to bringing home to the selling farmer his responsibilities under the Act, and to the buying farmer the advantage he derives from getting properly tested seed. Good results

in this connexion are believed to have been obtained by the exhibit illustrating the Seeds Act which is displayed at a large number of agricultural shows, corn exchanges and markets. It is possible in this way to get into touch with a considerable number of farmers in a practical and economical manner. Numerous visits are paid to individual farms for the purpose of discussing seed questions and drawing investigational samples for testing, but this method of reaching the farmers is too expensive to permit of unlimited extension. County agricultural staffs and farmers' organizations give valuable assistance with regard to the publication of articles and facilities for lectures. The Ministry also gets into immediate contact, either by letter or by the visit of an Inspector, with farmers who advertise that they have seeds for sale, and it is satisfactory to note, in this connexion, the large proportion of farmers' advertisements which now refer to the fact that the seeds they are offering have been officially tested.

Visits to Seedsmen.—The total number of visits paid by Inspectors of the Ministry to seedsmen's establishments in connexion with the administration of the Seeds Act during the season 1925-26 was 8,100 as compared with 5,500 during the season 1924-25. The tendency during the previous two years had been to lessen the number of these visits, but under a new arrangement of localized inspections which was put into operation during the season 1925-6 it was found possible to reach a large number of small traders, some 2,050 in all, who had not been called upon before. The bulk of these small traders were found to be selling seeds only for a short period of the year and as a "side-line" to their normal business. This must not, however, be taken as an indication that there is an extension of this class of sale. It merely arose out of the new inspection arrangement which enabled the local inspectors to comb out some of the remoter districts and densely-populated areas, which had not previously been dealt with intensively. On the contrary, evidence from all parts of the country tends to show that the requirements of the Seeds Act are causing the small "side-line" trader either to cease selling seeds or to confine this side of his business to the sale of packets which he obtains from reputable seed houses on a sale or return basis. This is satisfactory, as it should lead to an improvement in the quality of the seeds sold, much of the inferior seed hitherto sold being handled by the "side-line" seller.

Another result effected by the Act, which was noticed particularly during the past season, is that retailers are buying

their seeds in much smaller quantities, and re-ordering as the season progresses, in an attempt to avoid carrying over stocks to the following season. Where seeds are carried over, however, it is noticeable that they are either discarded or that the requirements of the Regulations are more closely followed in respect of retesting before the seed is again offered for sale. Retailers are also displaying greater discrimination as regards the sources from which they purchase their supplies. By obtaining their seeds from a reputable wholesaler they find they safeguard themselves against the possibility of selling seeds of an inferior quality. More care is also given to the preparation of seed mixtures.

Control Sampling.—During the season Inspectors of the Ministry drew 1,492 samples of seed on seedsmen's premises for the purpose of check testing at the Official Seed-Testing Station. This was a slight increase, *viz.*, 74, on the total of such samples taken during the previous season. These samples included 247 clovers, 162 grasses, 21 field seeds, 202 roots, 401 vegetables, 100 cereals, and 359 packeted seed. The check tests showed that the declaration of the seller was incorrect in some material particular in the case of 20 samples of grass seed, 18 of clover, 2 of field, 4 of root, 23 of garden, and 5 of cereal seeds. In 10 cases the germination was shown to be incorrect to the extent of from 10 to 15 per cent., 10 differed in this respect by from 15 to 20 per cent., and in 11 cases the figure of germination was found to be over 20 per cent. out. The purity was wrong to the extent of from 3 to 5 per cent. in seven cases, from 5 to 10 per cent. in nine cases, and over 10 per cent. in four cases. In the other cases the principal sources of error were in connexion with the presence of injurious weed seeds or dodder, and in a few cases only were the necessary particulars completely omitted. Taken as a percentage of the total number of control samples drawn, the discrepancy cases represent 6·6 per cent., as compared with 7·7 per cent. in 1924-25, 9 per cent. in 1923-24, and 11·5 per cent. in 1922-23—an encouraging improvement.

Packet Seed.—Of the 359 control samples of packet seed taken during the season 95·5 per cent. were found to be at or above the minimum standards laid down by the Regulations, as compared with 94 per cent. in 1924-25 and 90·6 per cent. in 1923-24. Of the samples found to be below the minima, 2 per cent. were above two-thirds of the standard and only 2·5 per cent., as compared with 4·4 per cent. in 1924-25, were

below two-thirds of the standard. Having regard to the increase in the sale of packet seed, this general improvement in the quality is very satisfactory.

Licensed Private Seed-Testing Stations.—The number of private stations licensed by the Ministry to test seed for the purpose of the Seeds Act is now 88, an increase of one during the season. Special inspections of these licensed stations were made during the course of the season, and some 840 samples taken for check testing at the Official Seed-Testing Station. These included 237 samples of cereals, 50 grasses, 208 clovers, 162 field seeds, and 183 vegetable seeds. Wherever the official check test did not confirm the result obtained at the licensed stations the matter was fully investigated to ascertain the reason for the variation. The seeds which, judging from the discrepancy cases, presented most difficulty in testing were peas, mangolds, oats, trifolium, and tares. As a further check on the testing at the private licensed stations a series of special " Referee " samples were issued to them from the Official Seed-Testing Station. These included uniform samples of cocksfoot, white clover, tares, lucerne, mangold, and swede. The results of these tests as compared with similar tests carried out at the Official Stations were fully discussed at the Seed Analysts' Annual Conference, to which reference is made later in this report.

Training and Examination of Seed Analysts.—The fifth course of training for seed analysts was held at the Official Seed-Testing Station from June 21 to July 20, 1926; 14 analysts attended the course and showed commendable keenness in their work. At the end of the course an examination was held, which was attended by 19 candidates, all of whom, it is satisfactory to note, were awarded a pass certificate. The practice of holding these annual courses of training and examinations is having a marked effect on the uniformity in practice at the various licensed stations, and it is also creating a pool of qualified analysts on which the licensed stations are able to draw when necessary.

Seed Analysts' Conference.—The Fourth Annual Conference of Seed Analysts was held at the National Institute of Agricultural Botany on July 24, and was attended by the analysts from most of the principal private licensed stations in the country. The Chief Officer of the Official Station reviewed the results obtained at the licensed stations on the series of " Referee " samples referred to above, and papers were read

on experiments with meadow foxtail, the occurrence of insect pests and fungus diseases in seed samples, and some new methods employed in the identification of certain kinds of grass seed. During the afternoon the British Association of Commercial Seed Analysts held its second annual meeting, when reports on the activities of the Association during the previous twelve months were received and other business transacted.

"**Seed Analysts' Bulletin.**"—Four numbers of this Bulletin were issued to seed analysts during the period under review. The purpose of this Bulletin is to keep all seed analysts in touch with developments in methods of testing, and generally to deal with any matters that may be of interest to them in connexion with their work.

Germination of Seed Peas, etc.—In the autumn of 1925 the Ministry issued a paragraph to the Press pointing out that there were indications that the germination of the 1925 crop of seed peas was below normal, and that, consequently, a considerable proportion of the seed peas marketed during the season would probably be found to have a slightly lower figure of germination than the minimum percentage prescribed in the Seeds Regulations, 1922. The sale of seeds with a lower germination than the minima shown in the Regulations is not illegal provided that a definite statement of the actual percentage of germination is delivered to the purchaser. A similar notice was issued to the Press with regard to the purity of parsnip seed. This seed, owing to its structure, frequently gives a purity figure of less than the 97 per cent. minimum referred to in the Regulations, the impurities being mainly "light" and imperfect seed. The sale of such seed is not contrary to the Regulations provided the actual percentage of purity is declared.

Seed Potatoes.—A considerable amount of work was carried out during the season in connexion with the section of the Regulations dealing with seed potatoes. The most frequent infringements of the Regulations in this connexion are as regards the statements as to size and dressing, and variety. Cases of inaccurate statements as to size and dressing arise of course in the early part of the year, and are reported to the Ministry either by the purchasers of the seed or by Inspectors who discover them in the ordinary course of their duties. It is understood that the Regulations have had a decidedly beneficial effect as regards the accuracy of the statements

now given by sellers as to the size of seed potatoes. Reported cases of alleged false statements as to variety fall roughly into three groups :—

(1) Those reported before the seed is planted, in which it is generally necessary to have an official sample grown on at a potato testing station ;

(2) Those reported by the farmer on the evidence of his growing crop, in which cases arrangements are immediately made for Inspectors of the Ministry to examine the crop and if necessary trace the seed back to the stage at which the mis-statement was made ;

(3) Those cases—and the greatest number of reports fall in this group—which are discovered by Inspectors in connexion with their inspections of growing crops under the crop inspection scheme for the certification of crops true to type.

Occasionally cases are reported on the evidence of a crop as lifted, but it is most desirable that the Ministry's attention should be called to alleged mixtures at an earlier stage when an examination can be made of the growing crop.

In all cases in which the Ministry is satisfied that there has been failure to comply with the Regulations suitable action is taken direct with the supplier responsible if he is situated in England or Wales, but in cases where the seed was obtained from Scotland the matter is reported to the Board of Agriculture for Scotland, that Department being charged with the administration of the Regulations in Scotland.

A number of cases were dealt with in this manner during the season 1925-26, but this may be taken as evidence of a spread of knowledge of the Regulations combined with more intensive inspection work by Officers of the Ministry rather than of an increase in the sale of seed potatoes wrongly described. On the contrary, it is believed that the requirements of the Seeds Act and of other regulations as to the sale and planting of seed potatoes are having encouraging results as regards the quality of the potato crops of the country.

Prosecutions.—It is satisfactory to note that during the season 1925-26 it was found necessary to take legal proceedings in fewer cases than in former years, a fact which supplements other indications that the requirements of the Seeds Act are being more closely followed than hitherto. The following are brief particulars of the cases taken during the season :—

On October 13, 1925, a case was heard at Birmingham against a local firm for selling onion seed with a declaration that the

germination was not less than the prescribed minimum, *viz.*, 60 per cent., but which was shown by a test on a control sample to germinate only 17 per cent. This is the second time the Ministry has had occasion to prosecute this firm. A conviction was obtained, and a fine of £5 imposed.

At Leicester, on April 10, 1926, a local shopkeeper was charged with (*a*) failure to display the necessary particulars alongside seed peas exposed for sale, and (*b*) failure to deliver the necessary statement in the case of a sale of seed peas. The defendant was fined £1 on each charge and £2 2s. 0d. costs.

On April 13, 1926, a case was taken at Ashford against an auctioneer for failing to give the necessary particulars in connexion with a sale by auction of a quantity of potatoes for planting. The Bench held that the potatoes were not seed potatoes and did not, therefore, come under the requirements of the Seeds Act and Regulations. The case was dismissed.

At Exeter, on August 7, 1926, a firm of seed and agricultural merchants was charged with making a false statement as to the percentage of germination of a consignment of Meadow Fescue seed. The defence put forward was that the bag from which the control sample had been taken consisted of old seed which was sent out owing to an error on the part of an employee. The Bench accepted the explanation, but decided that, as the firm was responsible for the actions of its employees, they must convict. A fine of £2 was imposed and £2 2s. 0d. costs.

In addition to the above, a number of cases were taken in Scotland for offences against the Seeds Act in connexion with consignments of seed potatoes supplied to English customers.

Amendments of Seeds Regulations.—No amendments have been made in the "Seeds Regulations, 1922," so that, unless some unforeseen circumstance should arise, the Regulations will be the same during the season 1926-27 as those which were in operation last season.

NOTE.—Copies of the Seeds Act, 1920 (price 3d. net); the Seeds (Amendment) Act, 1925 (price 1d. net); and the Seeds Regulations, 1922 (price 3d. net), may be obtained through any bookseller, or direct from His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2.

HUBAM SWEET CLOVER

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WHEN a new plant, or a new strain of one already known, is recommended to farmers for cultivation, they naturally wish to have full particulars about it. With the object of getting some practical information about Hubam sweet clover (*Melilotos alba* Desr.), which has been advocated as a valuable crop for British agriculturists, a series of trials lasting over three years has been carried out on the botanical plots at the Seale-Hayne Agricultural College.

Description.—Hubam sweet clover is not a clover but a melilot, and is an annual strain of Bokhara clover, this latter being a white-flowered biennial melilot. The melilots are erect and taller than clovers, and the flowers, instead of being grouped into a globular head, are situated round a long, central axis, technically known as a raceme. It owes the term "sweet" to the presence of cumarin, a sweet-smelling substance, which is also present in sweet vernal grass. Hubam sweet clover (sometimes called Hughes' sweet clover), although it closely resembles the Bokhara clover, differs from it in being an annual and in not having the thick root stock of the Bokhara; also, its vegetation is more tender, delicate, and a lighter shade of green. It was noted during the trials that an appreciable number of the sweet clover plants lived for two years, and, in saving seed from them, the number of biennials increased, these being exactly like the Bokhara clover plants. If this phenomenon is at all usual, in a short time there might be more Bokhara than Hubam sweet clover plants.

Observations on the Trials.—The situation of the trial plots is approximately 350-400 feet above sea level, facing south-east. The geological formation is Upper Devonian, and the underlying rocks are shales. The soil is a silt, tending to cake and crack in dry weather, and is inferior to the area of rich, red soil typical of many parts of Devon.

The seed bed must be well prepared and the soil free from weeds, as the young plants are readily affected by shading and competition, although, when several inches high, they can hold their own. To ensure true seed for these experiments, a supply was obtained direct from the United States, and was, presumably, correct,

It was found that the best times to sow were either in the late autumn, preferably in the shelter of a cereal stubble, or in late spring, when there is no longer any danger of frosts and cold winds. Autumn sowing is risky, as the seeds often do not germinate till spring, and if cold or frost follows, a heavy toll is taken of the seedlings, which are very tender and much affected by weather. Heavy losses may result from drought, cold winds, frost, or excess of moisture. The early stages of growth are, in fact, the most critical of all, but if the plant survives them, there is not much difficulty with the later stages.

Drilling gave much better results than broadcasting. In broadcast areas, many seedlings never broke through the surface of the seed bed, while others were so weakened that they died. In drills, which, in these experiments, were ten inches to a foot apart, the combined efforts of the seedlings lifted the earth and a good germination was obtained. Where drilled, too, weeding was a simple matter, whereas in broadcast areas it was practically impossible.

The depth of sowing, obviously, depends very largely on the nature of the soil. In the rather heavy soil on which these experiments were conducted, the best results were obtained when the seeds were sown at a depth of one inch. Those sown half inch deep came next, but gave 50 per cent. less yield, and at two inches very slightly less. In sowing a little below the surface, the young plants have the advantage of protection against the weather ; and, if drought follows, the root system, being deeper, can usually obtain some moisture, which may not be possible with a depth of only half inch or less.

Sowing at the rate of 30 lb. of seed per acre gave the best results. With a heavier sowing, the plants were feeble and the yield less ; and with a lighter sowing the plants were bushy and woody and the yield smaller. If sown for seed, however, the plants should be well apart, and a lighter sowing will be more satisfactory.

Hubam sweet clover grows well with thinly sown cereals, and even to a certain extent with vetches, but rye grasses depress it very much and it usually fails when sown with them. The cutting stage of Hubam sweet clover was found, generally, to be reached early in September, the cold spring winds and the summer drought tending to retard its growth.

General Conclusions.—As a crop, Hubam sweet clover, being an annual, would be used for a " one year ley," either alone or mixed with another legume or a lightly sown cereal.

It should be cut before flowering. Fed alone, stock would probably either eat it sparingly, or refuse it. When grown with grasses, it was frequently left, the grasses alone being eaten. If stock can be induced to eat it, then growing alone is the best method. For silage purposes, a good crop of Hubam might prove useful, especially if mixed with other material. Like lucerne, which it resembles in appearance, it will be better cut green than grazed or made into hay.

Theoretically, the feeding value of Hubam is fairly high, as can be judged from the following analyses of sweet clover and other legumes :—

ANALYSES OF GREEN PLANTS
(*Henry and Morrison : "Feeds and Feeding"*)

	Water	Ash	Crude protein	Fibre	Nitrogen free extract	Fat
Lucerne	74·7	2·4	4·5	7·0	10·4	1·0
Sweet clover ..	75·6	2·1	4·4	7·0	10·2	0·7
Crimson clover ..	82·6	1·7	3·0	4·7	7·4	0·6
Red clover	73·8	2·1	4·1	7 3	11·7	1·0
Sainfoin . ..	74·4	2 4	3 8	6·2	12·4	0·8

Hubam is not nearly so robust as the biennial Bokhara clover. The latter has never been extensively used in this country, for its bitter taste (due to the presence of cumarin), and the great toughness of the stem are serious objections. There are also other leguminous plants which give better results. The susceptibility of Hubam sweet clover to soil conditions, weather, and climate render it a very doubtful proposition even in favourable circumstances. When cut early, before the stem hardens, the yield is not any higher than can be obtained from clover and other legumes. It is also very susceptible to attacks from turnip flea beetle, which can do severe damage, and in many districts would make it practically impossible to raise a crop. The only point of interest is that the flowers are considered of great value for the production of honey but that concerns the beekeeper rather than the farmer. Apart from this it is evident that the disadvantages are so many and serious that it is not a plant that can be recommended under the ordinary conditions of British farming. In many parts of Canada, where sweet clover has been tried, it was not a great success and has since become an objectionable weed. There are doubtless cases where it may be successfully grown, and in circumstances where other legumes fail, but such cases are exceptional. Anyone considering Hubam sweet clover as a crop should first consult the County Organiser, or try it only on a small scale.

EGG AND POULTRY MARKETING DEMONSTRATION

IN the last (November) issue of this JOURNAL (p. 689) was published a note giving particulars of the marketing demonstrations contemplated by the Ministry as part of the work which is to be carried out with the aid of the grant from the Empire Marketing Board. It will not be possible to operate the full programme until the spring and summer of next year, but a preliminary demonstration was staged at the poultry show at Bingley Hall, Birmingham, on November 2-4, which was held under the joint auspices of the Birmingham Agricultural Exhibition Society and the Midland Federation of Feather and Für Societies. The commodities dealt with on this occasion were eggs and poultry, a separate section of the demonstration being devoted to each.

(1) **Eggs.**—Eggs will not look well, keep well, or sell well unless they are clean in the nest, cleaned if necessary when collected, candled for quality, graded for size, properly and attractively packed, held under sound conditions, and reach the consumer in the shortest possible time after laying. These points were all demonstrated at Birmingham. The handicap under which those home producers who ignore them place themselves was illustrated by the display not only of samples of home-produced eggs, but of cases of graded eggs from other parts of the Empire—Northern Ireland, the Irish Free State, Canada, South Africa, and Australia—and from near-European countries, including Holland, Belgium, France, and Denmark, all of which find their principal export market here.

The latest ideas in economical and efficient packing were shown by a comprehensive display of the various types of returnable and non-returnable boxes, and of other commercial packages. There was also a continuous demonstration of candling and grading. In the candling room, the various methods of testing the quality of eggs, both in bulk and singly, were shown. Candling should be undertaken by wholesale distributors as an essential safeguard to their business.

The grading exhibit brought to the notice of producers, in most cases, probably, for the first time, a mechanical egg grader of a type now largely used in Ireland (Fig. 1). This consists of a series of trays placed over one another, the holes of which coincide in position, but diminish in size in

each successive tray. The eggs are placed in the top series of holes, and according to size come to rest in one or other of the trays. Large-scale producers, dealers, producers' co-operative societies, and all who handle eggs in bulk should make a practice of grading their consignments. What is required, however, is not a multitude of grading systems, but one standard system. The standard grades suggested by the Ministry were the subject of an impressive and much admired display (Fig. 2), which will not readily be forgotten by those who saw it.

(2) **Poultry.**—The poultry marketing exhibit directed attention in the first place to the right stage at which to market fowls. It frequently happens that, either through neglect or ignorance, large numbers of surplus birds are placed on the market at unsuitable and unprofitable stages of development; simple illustrations of this were on view. The methods of conditioning and fattening birds by trough feeding and cramming were also demonstrated; experience in other countries suggests that these processes can often best be undertaken by buyers, who kill and dress the birds for market. The best methods of killing, plucking, and dressing poultry for the market were shown, and attention was drawn to the value of sorted feathers.

The adequate grading of poultry is rarely practised in this country, and, even where it is attempted, the lack of a uniform system of classification proves a serious disability. The Ministry's suggestions in this respect were illustrated by a display of birds graded according to quality and weight (Fig. 3). This new departure attracted much attention. The possibilities and advantages of grading were further illustrated by packs of birds from the Dominions and foreign countries. Various types of inexpensive non-returnable boxes well suited to the trade were on view.

(3) **Cold Storage.**—The carrying over of seasonal surpluses to meet trade demands when supplies are short is a necessary public service. The various methods of preserving eggs in lime-solution, water-glass, gas, and by guaranizing and other means were shown. Further, since the special methods of preparation and packing that are desirable for produce intended for cold store are neither widely known nor understood, an exhibit dealing with the cold storage of both eggs and poultry was arranged in conjunction with the Low Temperature Research Station at Cambridge. The small chilling plant shown was of particular interest to wholesale buyers in country districts.

FIG. 1—Egg and Poultry Marketing Demonstration at Birmingham. A view of the egg grading and packing section, showing the mechanical grader, also the candling room

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FIG. 2. Egg and Poultry Marketing Demonstration at Birmingham. Display of English eggs graded in accordance with the suggestions of the Ministry.

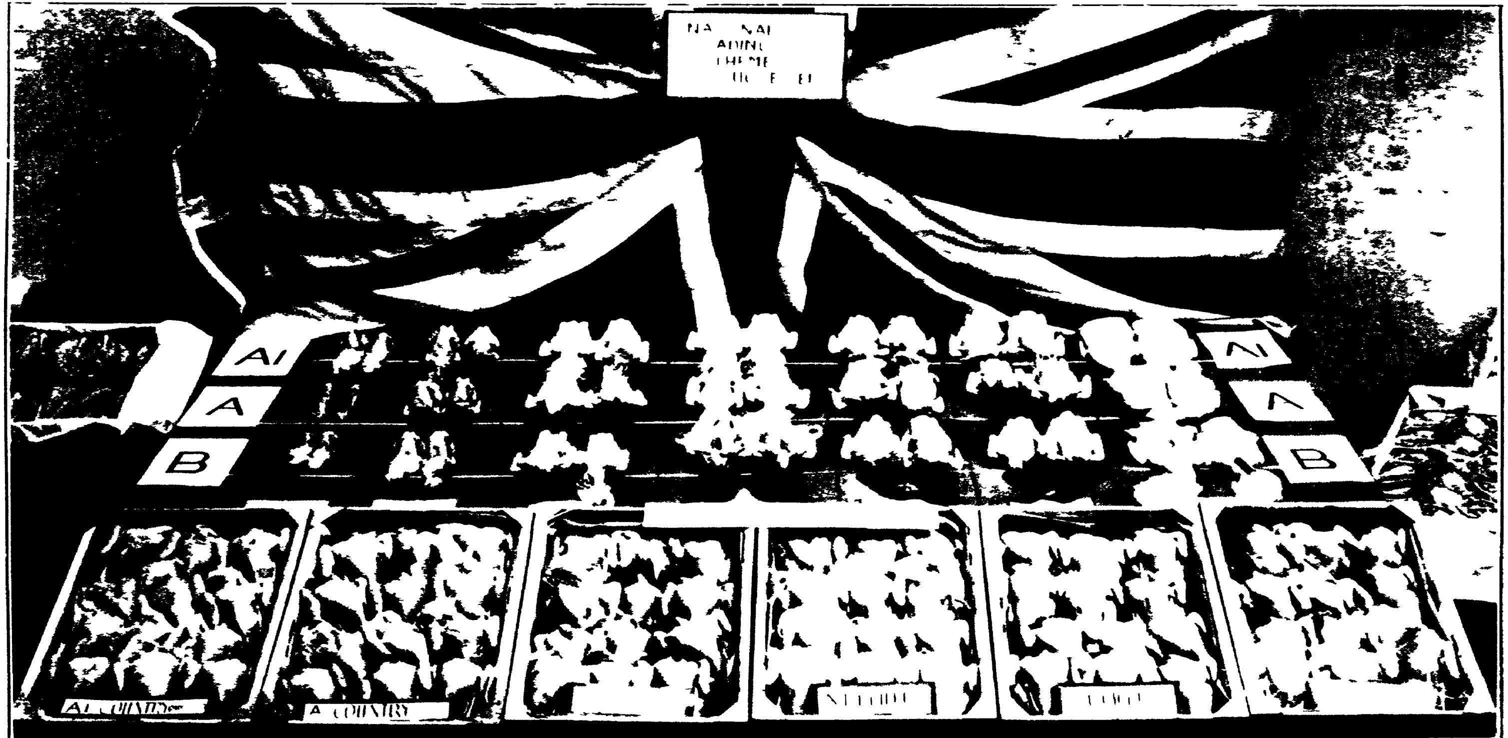

Fig. 3. Egg and Poultry Marketing Demonstration at Birmingham. Display of English fowls and ducks classified, graded and packed in accordance with the suggestions of the Ministry.

The remarks of visitors and references in the Press afford ample evidence that the exhibit was widely appreciated. The recently issued Reports* on the marketing of eggs and poultry were in keen demand, and nearly 600 copies were sold.

Elsewhere in this issue (pp. 858–861) will be found hints on the marketing of eggs and fowls. It is proposed in future issues to deal more fully with the question of grading these two commodities.

COUNCIL OF AGRICULTURE FOR ENGLAND

THE Twenty-Second Meeting of the Council was held at the Guildhall, Westminster, S.W., on Tuesday, October 26, 1926, Lord Clinton in the chair.

Statement by the Minister of Agriculture.—The Rt. Hon. Walter Guinness, M.P., Minister of Agriculture, in the course of his address to the Council, reviewed the chief agricultural happenings in the five months since the last meeting. He said that, although agriculture had not been directly concerned in the industrial troubles, there was evidence on all sides that producers were suffering from the fall in the purchasing power of the community. The harvest, which promised well, had proved to be somewhat disappointing. The potato crop was estimated at 3,630,000 tons, as against 4,209,000 last year on a smaller acreage. It was too early to foresee what would be the trend of potato prices, but the farmer might hope that prices would rise before foreign imports were attracted to this country. The Minister referred briefly to the position of the Weighing of Cattle Bill and Land Drainage Bill, both of which had been passed, the Small Holdings Bill, the Rural Housing Bill, the Merchandise Marks Bill, the Fertilizers and Feeding Stuffs Bill, and the Horticultural Produce (Sales on Commission) Bill. He did not suggest that there was anything sensational in the Parliamentary programme, but its cumulative effect should be very considerable.

Mr. Guinness said that it was remarkable that the problem of marketing had lagged so far behind other agricultural problems. For years past the farmer had devoted his attention to reducing costs, and science had come to his assistance by labour-saving devices, by new varieties of crop, by improved

* *Report on the Marketing of Eggs in England and Wales*, Economic Series No. 10. *Report on the Marketing of Poultry in England and Wales*, Economic Series No. 11. Obtainable from His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2, price 6d. each net.

fertilizers, by control and prevention of pests and diseases. But it was only recently that any great effort had been made to try to increase receipts by organized selling. In the last few weeks the Ministry had added to the orange-covered books of the "Economic Series" Reports on the Marketing of Pigs and on the Marketing of Poultry. The National Farmers' Union had published an admirable Report on Co-operative Bacon Factories. In the Pig Report, it appeared that, although the consumption per head had steadily increased, the production in this country had remained stationary, the shortage being made up by importation from overseas. The Report suggested concentration on supplying the British market for fresh pork and displacing foreign supplies of mild-cured bacon. Even this programme, which dealt with less than half our total imports of pig meat, would mean another 3¾ million pigs every year, which was more than the total pig population at the present time. Undoubtedly, the encroachments of Danish bacon in our markets were largely due to the standard of uniform quality in their grades which the Danes were able to maintain. The Report, therefore, advised more co-operation between the farmer and the curer, and pointed out the shortcomings of our present system.

The Report on Poultry Marketing was more cheering, because the British poultry producer was still in a dominant position in our markets. Here, again, the reason foreign produce often got a better price was that it was much better packed and graded. The foreigner, however, could arrange to send us only his best, whereas this country had to absorb all qualities of home produce in its own markets. Recognition had been obtained from the Empire Marketing Board of the importance of research work in marketing being carried out by the Ministry.

With regard to foot-and-mouth disease the position was much better than this time last year. Three outbreaks only had occurred since October 1, and they were all restricted now to very small areas. He could not sufficiently impress upon agriculturists the importance of the immediate notification of foot-and-mouth disease ; in one recent case the lesions were twelve days old before the case was reported. Compare the figures of outbreaks here with those of neighbouring countries. In Denmark in June they had 13,200 outbreaks ; for the last three available months Holland had 22,665 outbreaks, Belgium 16,849, and France 21,768. It was no imaginary danger, therefore, with which the Ministry was dealing when

it shut out supplies of foreign fresh meat and mild-cured bacon.

Mr. W. R. Smith asked whether any compensation was given in the case where the lesions were twelve days old before reporting. The Minister replied that he did not think the case had been finally settled yet, but the practice was that where an offence was proved before a local court, compensation was withheld. Mr. Smith also asked whether figures were available as to the outbreak in Sweden, where a very strict policy of slaughter existed. The Minister promised to send Mr. Smith what information the Ministry had.

Size and Dressing of Seed Potatoes.—The Rt. Hon. Sir Francis Acland, Bart., as chairman of the Standing Committee of the Council, moved the adoption of its Report on this subject, which showed that there were, at the beginning of the growing season of this year, several complaints by farmers that the seed potatoes sent to them from their Scottish dealers were not in accordance with the size and dressing stated on the invoice. Irregularities of this kind were contraventions of the Seeds Regulations made by the Ministry of Agriculture under the Seeds Act, 1920, and when reported were dealt with by the Department and by the Board of Agriculture for Scotland. It was not suggested that complaints of the kind had been more numerous this year than in previous seasons, as it was reported that the Seeds Regulations were bringing about an improvement of the general position, but the Committee recommended that consignments should be thoroughly examined on delivery and that where variations between the invoice particulars and the consignment did occur information should in all cases be sent forthwith to the Ministry of Agriculture at 10, Whitehall Place, S.W., for consideration by it, in conjunction with the Board of Agriculture for Scotland, as to whether legal proceedings should be taken under the Regulations. Lord Bledisloe, Parliamentary Secretary of the Ministry, said that the Ministry was able to endorse what was said in the Report. There had been three convictions this year, which should serve as a warning. Mr. Patterson asked whether a consignee, receiving a sample that he considered defective, could get an inspection made by anyone representing the Ministry. Lord Bledisloe replied that the consignee must look after his own interests. He was afforded full protection under the Seeds Act to obtain the assistance of the Ministry if, in fact, he got an invoice which did not tally with the goods.

Sheep Scab Policy.—Sir Francis Acland presented a Report from the Standing Committee which summarized the Ministry's Circular Letter of July 14, outlining its policy. The letter indicated—

> that judging from the views expressed by leading agricultural organizations a policy of general compulsory dipping throughout the country would not be acceptable to sheep-owners in a large part of England and Wales and the greater part of Scotland. The Minister had therefore decided not to proceed further with the proposals which had been embodied in the Draft Order on the subject (previously circulated), but to postpone them until there was a demand on the part of agriculturists as a whole for their operation. This being the case, it was intimated that the Department would direct its efforts principally to the improvement of the existing methods of dealing with outbreaks of Sheep Scab on individual premises and in infected areas. An endeavour would also be made to limit the extent of the double dipping areas to the actual locality of the outbreaks.
>
> The letter stated further that it had been suggested that the Ministry should withdraw the existing powers of local authorities so as to leave the field clear for the operation solely of the Ministry's Orders. The Minister was, however, unwilling to do this, though he urged on local authorities the importance of considering carefully the effect of each regulation they made upon the normal movements of the sheep trade and of avoiding as far as possible any undue interference with them. Where groups of counties are comparatively free from Scab or where the position as regards the disease is similar in adjoining counties, local authorities were invited to combine into a single unit with agreed Regulations, in identical terms, providing for the treatment of sheep admitted from outside their area, but giving freedom of movement within the boundaries
>
> The letter also recommended that in districts where regulations already existed requiring double dipping within the preceding twenty-eight days of sheep intended to be moved to a market in their district from outside the district, the period should be extended to fifty-six days Further, it was stated that the Ministry did not propose to interfere with the discretion of local authorities in requiring periodical dipping of sheep in cases where precautionary single or double dipping was required, though it desired to make it clear that neither single dipping nor double dipping at intervals longer than fourteen days was sufficient to eradicate Scab.
>
> The Standing Committee considered that the Council should note this position and should urge local authorities to take prompt action on the lines recommended so that the disease may be restricted in the country as much as possible.

Mr. J. M Paine (Bucks) objected to the extension of the period of twenty-eight days mentioned above to fifty-six. The Minister replied that great inconvenience had been caused owing to the differing period with regard to allowing movement which had been imposed in the country. Many representations had been made of the great hardship inflicted on those who wished to send sheep from a clean area by the fact that the

unnecessarily short period of twenty-eight days only was allowed during which the dipping was held to make sheep safe. As a matter of fact, twenty-eight days was not safer than fifty-six, provided that the sheep were kept isolated from undipped sheep during the fifty-six days. On that account, after consulting the interests concerned, the Ministry was now making an Order to substitute fifty-six days throughout the country for the varying periods which had so far been enforced. On the general question, the Minister agreed with Sir Francis Acland that it was disappointing that there should not be a policy of root-and-branch eradication of the disease, but it must be remembered that, of the 15 million sheep in the country, only about 100,000 came under the Ministry's Order each year for Sheep Scab. The disease, moreover, was not one with very serious results. On the whole, he did not think it practical politics to try to force the eradication policy on reluctant districts against their will. After further discussion, in which Mr. Paine, Mr. W. R. Smith, Mr. Patterson (Staffs), and Mr. R. W. Hall (Hereford) joined, the Report was adopted.

Rural Housing.—Sir Francis Acland, on behalf of the Standing Committee, moved the adoption of their Report on this subject. The Report was in three parts; the first drew attention to the provisions of the Housing (Rural Workers) Bill, which had received its Second Reading in August last, and had been committed to a Standing Committee. The Bill is designed to promote the provision or improvement of housing accommodation for agricultural workers, and others whose economic position is substantially the same, by authorizing the giving of financial assistance towards the reconstruction and improvement of houses and other buildings. The local authorities defined by the Bill may assist in three ways:—

(1) By way of grants which may be given:—
  (*a*) In the form of lump sum payments; or
  (*b*) In the form of periodical payments.
(2) By way of loans which may be made by instalments as the works progress.
(3) Partly by (1) and partly by (2).

Assistance can only be given in cases where the estimated value of the dwelling, when improved, does not exceed £400, and where the estimated cost of the works exceeds £50. Grants may not exceed two-thirds of the estimated cost of the work or £100 per dwelling. For twenty years after improvement, the dwelling may not be occupied except by any person whose income is such that he would not ordinarily pay a rent in excess of that paid by agricultural workers, and the owner

may not receive a rent for the improved cottage in excess of the normal agricultural rent plus 3 per cent. of the amount by which the estimated cost of the works exceeds the amount of the assistance by way of grant. The Government contribution, proposed to be made to local authorities towards their expenses incurred in making grants, is an annual payment for twenty years, equivalent to half the loan charges on money raised by the local authorities for the payment of grants.

The second part of the Report gave particulars of the Welwyn R.D.C. Housing Scheme, under which a reduction of rent is made by the Council in respect of the number of children maintained by the tenant, and an addition to rent made in respect of any lodgers. A normal rent is fixed for each type of house, and 1s. added per week for each lodger, and 6d. per week deducted for each child under sixteen years of age. The scheme was stated to be working quite well. Inquiry at the Ministry of Health had failed to elicit information of any similar schemes in operation in the country, though that might be due to the fact that that Ministry would not necessarily be informed of their existence.

The third part of the Report requested the Council to reiterate the Standing Committee's views as to the serious shortage of houses for agricultural workers expressed in a Report which was adopted by the Council on March 19, 1925, and to emphasize that it was inadvisable that any early modification should be made of the present statutory provisions under which part of the shortage is being met.

Sir Francis added that a good deal of work was being done by rural district councils, particularly under the last Housing Act. All district councils were not, however, equally active, and it would be a great misfortune if the Exchequer's present generous help towards housing was stopped before a real improvement had been effected in all districts. It really paid district councils to tackle housing, for if they could avoid having to send one child to a sanatorium for treatment of disease contracted through overcrowding they would save the expenditure on several houses in a year. They, also, got back in rates on new houses a very considerable proportion of the amount of the small subsidy which they paid.

Mr. Guinness said he would convey the recommendations of the Council to the Minister of Health. It had never been suggested that a sudden end should be made of the housing subsidies. As to figures, up till October 1 of this year, 7,768 houses in rural parishes had been authorized for subsidies

under the 1924 Act, and 2,283 of them had been completed. No figures existed as to houses erected in agricultural parishes under the Acts of 1919 and 1923. Taking all rural districts, however, since 1919 166,000 houses had been authorized under the Acts and 113,000 completed. The Minister of Health had said that it was the general policy of the Government to bring to an end the subsidies under the Acts of 1922 and 1924 as soon as practicable ; but it was recognized that this could only be done gradually. No decision had been announced as to what reductions were under consideration, but in any case assurance had been given that all houses that are completed by October 1 next year would be eligible for the subsidy. Sir George Courthope, M.P. (East Sussex), desired to impress on the Council the importance of getting an amendment of the definition of "agricultural parish" in the Housing Act, 1924. He said that the opportunity occurred in connexion with the Bill now before Parliament. Mr. W. R. Smith agreed, and added that the figures which the Minister had presented were, in some respects, misleading. The houses referred to were almost all of the small villa type. If the point raised by Sir George Courthope would make it easier for the authorities to provide for the agricultural worker he would support its fullest consideration. Mr. J. Beard said that no one should be led by the figures given to assume that agricultural labourers lived in the cottages referred to. The Report was adopted.

Agricultural Unemployment Insurance.—The Minister explained that he was asking the Council's advice on this Report at short notice. The Committee making the Report had been set up chiefly at the instance of this Council, and since the Council were familiar with the question he would like to have the benefit of their opinion. He would not be able to state the decision of the Government at this stage, as other Departments—the Treasury and Ministry of Labour—were concerned, but he could assure the Council that its opinion would be given very great weight by the Government, and he hoped that before the Council met again the Government's decision would have been taken. Mr. James Donaldson (Oxford) moved :

> That the Majority Report on Agriculture Unemployment Insurance be not accepted, as in the opinion of this Council no case had been made out for the inclusion of Agriculture in any Unemployment Insurance Scheme.

He did not think that the position had materially altered since 1920, when agriculture had been deliberately left out of the

scheme. He would have expected the Committee to concentrate first on the question whether there was more or less unemployment in agriculture to-day than in 1920. He did not see, further, why Scotland should be recommended for exclusion from any scheme that was to be obligatory in England. On a calculation of 3d. from the employer and the employee and 3d. from the Government there should be something like £900,000 per annum. The scheme stated that only £250,000 would be required. Where would the rest be going? Would it be treated in the same way as the National Health Insurance surpluses were being treated, *viz.*, by confiscation? Sir Douglas Newton, M.P. (Camb.), in seconding the motion, said he could not conceive any report upon which it would be more difficult for the Government to found legislation than this one. He considered that the whole question turned upon the extent of unemployment and the right of the casual worker in the industry to insurance. The regular worker did not see why he should be mulcted for the benefit of casuals drawn largely from other industries. Mr. Denton Woodhead said that he was sorry the Council was asked to come to a decision to-day. There had been a great deal of evidence heard and weighed, and it was unfair if the Council were forced to make a hasty decision. There might be altogether different circumstances in 1926 to those present in 1920. The worker was now in favour of being included in some scheme of Unemployment Insurance. Farmers were giving the minimum of employment, and if men were to be thrown out of work some provision ought to be made for them. Circumstances in Scotland were quite different from those in England. With regard to the latter country, he was satisfied that a case had been made out. Mr. Donaldson had spoken on surpluses. The Report recommended a scheme which would obviate entirely surpluses which could be taken over by any other body. He moved an amendment:

> That the Council of Agriculture approves the Majority Report and urges the Minister of Agriculture to introduce a Bill on the lines of a special scheme for agricultural workers as early as possible.

Mr. G. E. Hewitt seconded the amendment. In the general discussion which followed, Sir George Courthope, M.P., Mr. Beard, Capt. Morris (Herts), Mr. Haman Porter, Mr. F. J. K. Cross (Berks), Mr. G. G. Rea (Northumberland), Mr. James Hamilton (Lancashire), Mr. T. Lovell, Mr. W. R. Smith, and Sir Francis Acland took part. The amendment was then put to the meeting and lost, the original motion being carried.

Empire Marketing Scheme.—Mr. Donaldson, on behalf of the Standing Committee, moved :—

> That the Council would be glad to be informed of the present position of the Empire Marketing Scheme and think it desirable that particulars should be published showing the allocation of grants under it.

The motion was duly seconded, and Lord Bledisloe, as representative of English and Welsh Agriculture on the Empire Marketing Board, said that at every meeting the members representing the various parts of the Empire realized to a greater extent the unity of their objective and the desirability of pursuing it in absolute harmony and unanimity. The Board had been in receipt of a vast number of suggestions for booming some particular Empire product, but it had decided first of all to plan out its sphere of operations. It resolved that its efforts should not be confined to the actual marketing of produce, whether from Empire or Home Sources, but that it should be directed to every stage of production and distribution. It was laid down that the marketing of Empire produce included the marketing of Home-grown produce: Home-grown first, and Dominion and Colonial second. The work of the Board resolved itself into two main branches, publicity and research, for each of which a Committee had been set up. An illustration of the work of the first branch was the Imperial Fruit Show. An illustration of the second was the provision of financial assistance for research into such a problem as the relation of the mineral content of pastures to the nutrition of farm animals. Another grant would probably be made to the Low Temperature Research Station at Cambridge, where invaluable experiments were taking place in the preservation of meat, eggs, fruit and various other produce.

In addition, the Marketing Board had made a grant to the Ministry of Agriculture for carrying out further investigations into the methods of marketing home-grown agricultural produce and for instructing home producers in improved methods. The grant was one of £40,000 per annum for the next five years. The demonstration in modern methods of marketing eggs and poultry to be given at the Birmingham Agricultural Show from November 2 to 4 would be the first of its kind carried out by the Ministry. Next year it was hoped to carry out similar demonstrations at the principal agricultural shows.

In regard to the publication of information, his Lordship said that a full report on the work of the Board would be published from time to time and it was not possible to inform the Council in advance of such publication. He would promise,

however, that every endeavour would be made regularly to bring before the Council the aspects of the work of the Board as they relate to Home Agriculture. Mr. Donaldson expressed himself, on behalf of the Standing Committee, as satisfied with the statement which had been made.

Agricultural Credit.—Sir Francis Acland moved :—

That the Council regrets that the Government has not yet been able to formulate a scheme to give effect to its policy for providing facilities for Agricultural Credit. In the Council's view, it is a matter of considerable importance that a scheme should be published as soon as possible so that it may be discussed and understood by the agricultural community before legislation is proceeded with.

Sir George Courthope, M.P., seconded. The Minister replied that he was just as anxious as the Standing Committee to find some solution of the very difficult question of long-term Agricultural Credit. There was no possibility of dealing with the matter this Session. The industrial and home credit outlook was very uncertain and the moment was not a very well-chosen one to press the demands for more credit. He was giving the matter very anxious thought and he welcomed this evidence that the Council still attached importance to finding a solution of the problem. Mr. Taylor (Norfolk) supported the plea for Agricultural Credit with an instance where it was badly needed. He said that a real Agricultural Credit Scheme would give security and confidence to a very large section of small men in agriculture. The motion was agreed to.

Sheep Worrying by Dogs.—Capt. E. T. Morris (Herts) moved :—

That this Council calls the attention of the Minister of Agriculture to the suffering and damage to sheep in various parts of the country, especially those adjacent to urban centres, through worrying by dogs. Such worrying results not only in suffering to the animals but in financial loss to sheep-owners and injury to the country's food supplies. This Council suggests that legislative action is necessary to secure that dog-owners keep their dogs under proper control.

He cited a case in which damage had been done to a flock of ewes to the extent of £216, the owner being able to recover only £50. His own county, Hertfordshire, was becoming increasingly urbanized, and flocks were suffering more severely from such worrying. The motion was seconded by Mr. T. Quinney (Birmingham) and the matter was then generally discussed, Lord Bledisloe, Sir Francis Acland, Sir Merrik Burrell (West Sussex), Mr. De Salis (Middlesex), Mr. W. R. Smith, Mr. Bruford (Somerset), Mr. G. E. Hewitt, and Alderman Davies (Durham) joining in the discussion. Lord Bledisloe said

that, only two years ago, he had lost the greater part of his lambs through worrying by dogs which he was unable to trace. There were 1,800,000 dog-owners and the difficulty the Council was up against was of extending the present legislation to cover the effective control of dogs by day as well as by night. The Ministry had exercised its powers so far as it could by approving night control Regulations of Local Authorities under Section 2 of the Dogs Act, 1906. Only London, Hampshire, Northumberland and Cardiganshire had not put these regulations into operation. Their effect was that all dogs should be kept confined in an enclosure from which it could not escape, be properly secured to a kennel by a chain and collar, or be accompanied by the owner or other person able effectually to prevent it from straying. No sufficient case had been made out at present for further legislation.

Sir Francis Acland stressed the point of obtaining some publicity in the Press and Mr. W. R. Smith asked that the Home Office should be requested to circularize the various police forces requesting them to give closer attention to this matter. Lord Bledisloe promised that both suggestions would be followed. The motion was then, by leave of the Council, withdrawn.

Humane Slaughtering of Animals.—Mr. R. G. Patterson (Staffs) moved :—

> That in view of the unquestionable suffering inflicted upon animals killed for human food, especially at the hands of inexperienced slaughtermen, this Council urges the Ministry of Health to do everything in its power to promote more humane methods of slaughter.

He did not think that there was any intentional cruelty in the slaughterhouse, but he held strongly that very serious and unnecessary suffering was inflicted upon animals by inexperienced slaughtermen. He said that objections were raised to the use of the humane killer on the ground that it was not always certain in its action, because an animal might move its head just as the gun was being fired ; but that objection applied with even greater force to the poleaxe. On the other hand, a wholesale butcher with considerable experience of the use of the humane killer on a large scale had told him that he had never known it to cause undue injury and suffering to an animal which was being slaughtered. As to the Jewish point of view, not the slightest attention need be paid to it one way or the other, because animals ought to be slaughtered as painlessly as possible. He might be told, of course, that local authorities already had power to impose the use of the humane killer in

their areas; but local authorities were often influenced by local considerations in exercising or not exercising their powers. In any event, public attention ought to be directed as much as possible to this matter, and the Ministry should encourage the use of humane methods of slaughter to the greatest possible extent, and should hold inquiries, if necessary, into the possibility of improving the implements in use for the purpose. Mr. F. J. K. Cross seconded the motion, which was put to the Council and agreed.

Report from Agricultural Advisory Committee.—The Report, No. 15, of the Proceedings of the Agricultural Advisory Committee for England and Wales, which follows, was laid before the Council.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES

Report (No. 15) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee. Three meetings of the Agricultural Advisory Committee for England and Wales have been held since the date of the last Report to the Councils, *viz.*, on May 19, June 23, and July 28, the Minister or the Parliamentary Secretary being in the chair on each occasion.

(1) **Milk and Dairies Order.**—This was dealt with at the meeting on May 19, when the Committee received the Report of the Sub-Committee, consisting of Lord Clinton (chairman), Mr. Strutt, Mr. Dallas, Mr. Donaldson, and Sir George Courthope. The Report suggested a number of amendments to the Draft Order which the Sub-Committee considered to be necessary in the interests of agriculturists. The Advisory Committee agreed to recommend them to the Ministries of Agriculture and Health for adoption, subject to certain amendments of its own. At the meeting on June 23, the chairman reported the amendments which had been made by the Ministry of Health as a result of the representations of the Agricultural Advisory Committee. He thanked the Committee for the help which had been given.

(2) **Foot-and-Mouth Disease.**—At each of the last two meetings the Committee was informed of the then existing position in regard to this disease. At the meeting of June 23 it was reported that the agitation which had followed the embargo on fresh meat from the Continent had become less pronounced. The suggestion was made that goods other than fresh meat

which might bring in the disease—for example, vegetables and their packings—might also be excluded. The Minister informed the Committee that the situation in regard to these and other imported materials would be carefully watched, but that he would not be justified in prohibiting the importation of any articles on suspicions alone. In the case of the exclusion of fresh meat carcasses, there was definite proof that disease had been introduced by their means. At the meeting on July 28 the Chief Veterinary Officer, Mr. Jackson, informed the Committee that a new kind of notice was being used to prevent the spread of disease from freshly infected premises. This notice, signed by the farmer and posted on his premises, made it a penal offence for any unauthorized person to enter them. It was reported that special precautions had to be taken in regard to animals shown at the Royal Show, owing to an outbreak which had occurred in Staffordshire. It did not appear that any spread of disease took place as a result of the Royal Show.

(3) **Empire Marketing Scheme.**—The Committee at the meeting on June 23 considered the Ministry's proposals for developing home marketing under this scheme. The main object of the proposals was to assist in carrying out the constructive suggestions which were being made in the series of "Economic Reports" of the Ministry. They were also intended to assist the continuance of the present investigation and research into existing marketing methods, and generally to help their improvement by means of publicity, propaganda, experiment and demonstration.

(4) **Agricultural Education and Research.**—At the meeting on July 28 the Committee considered a memorandum which had been circulated by the Ministry on the finance of agricultural education, research and live-stock improvement during the five years ending 1931. The matter was discussed and agreed, subject to the further consideration of certain views which had been expressed by members in the course of the debate.

(5) **Report of the Proceedings of Other Committees.**—A Report of Proceedings of the various Advisory and Departmental Committees of the Ministry for the five months ending June 11, 1926, was presented at the second meeting named above. The great loss which the Department and Agriculture had sustained through the deaths of Sir Stewart Stockman and Sir William Leishman was made the subject of a special resolution of the Committee, expressing their deep regret and their sympathy with the families of these eminent scientists.

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1926

Produce of Crops.—Preliminary statement showing the estimated total produce and yield per acre of the corn and hay crops in England and Wales in 1926, with comparisons for 1925, and the average yield per acre of the ten years 1916-25.

NOTE.—Apart from wheat, corn crops have yielded as well over the country as a whole as was expected immediately before harvest, and yields per acre of barley and oats are well above average. In many districts, more especially in eastern counties, wheat threshings gave results much below the good yields anticipated, but over the whole of England and Wales the yield per acre is not very much below average. There was favourable weather during the greater part of the harvest and most of the corn was secured in dry condition. The grain is usually of good quality.

The yield per acre of WHEAT is estimated at 16·7 cwt., or ½ cwt. less than the average of the ten years 1916-25, and nearly 1½ cwt. lower than last year. Yields are relatively poorest in the eastern counties, where the crops average only 15¾ cwt. per acre, or 1⅝ cwt. below the ten years' average for those counties. The estimated total production is 1,326,000 tons, or 34,000 tons less than last year, the reduced yield per acre more than counterbalancing the increase of nearly 100,000 acres under this crop. BARLEY yielded 16·2 cwt. per acre, or 1½ cwt. above average, and practically 1 cwt. more than last year. The yield per acre of barley this year is higher than in any year since 1909. Every division of the country has over average crops. As a result, however, of the much reduced area the total production of 927,000 tons is 83,000 tons smaller than in 1925. The estimated total production of OATS is 1,497,000 tons, or 118,000 tons more than last year, although the area was slightly reduced. The yield per acre of 16·1 cwt. is over 2½ cwt. above average and has only once been exceeded during the forty years for which official estimates are available. Yields more than 2 cwt. per acre above average were obtained in every division except South Wales, and this division secured a crop 1⅜ cwt. above its ten years' average. MIXED CORN gave a crop of 15½ cwt. per acre and the total production of 88,000 tons is about 6,000 tons less than last year as a result of the reduced area. On the whole BEANS have yielded better than was anticipated, but some counties on the eastern side of the country obtained very poor yields. The yield per acre

PRODUCE OF CROPS.

Crops		Estimated Total Produce 1926	Estimated Total Produce 1925	Acreage 1926	Acreage 1925		Estimated Yield per Acre 1926	Estimated Yield per Acre 1925	Average of the Ten Years 1916-25
				Acres	Acres				
Wheat	Tons	1,326,000	1,360,000	1,592,207	1,499,496	Cwt.	16·7	18·1	17·2
	Qrs.	6,01[illegible],000	6,127,000			*Bush.*	30.2	32·7	31·2
Barley	Tons	927,000	1,010,000	1,147,647	1,317,584	Cwt.	16·2	15·3	14·7
	Qrs.	4,85[illegible],000	5,208,000			*Bush.*	33·7	31·6	30·7
Oats	Tons	1,497,000	1,379,000	1,863,452	1,867,611	Cwt.	16·1	14·8	13·5
	Qrs.	10,722,000	9,522,000			*Bush.*	46·0	40·8	38·6
Mixed Corn	Tons	88,000	94,000	113,478	123,370	Cwt.	15·5	15·2	—
	Qrs.	43[illegible],000	551,000			*Bush.*	37·5	35·8	—
Beans	Tons	159,000	159,000	201,703	179,303	Cwt.	15·8	17·7	15·6
	Qrs.	696,000	689,000			*Bush.*	27·6	30.7	27·3
Peas	Tons	53,000	64,000	72,699	88,486	Cwt.	14·7	14·6	13·7
	Qrs.	240,000	286,000			*Bush.*	26·4	25·9	24·6
Seeds Hay*	Tons	2,353,000	2,56[illegible],000	1,577,789	1,722,088	Cwt.	29·8	29·8	28.5
Meadow Hay† ..	Tons	4,776,000	4,538,000	4,358,355	4,311,626	Cwt.	21·9	21·1	21·1

* Hay from clover, sainfoin, and grasses under rotation. † Hay from permanent grass.

over the whole country is estimated at 15·8 cwt., or very slightly above average, and the total production at 159,000 tons, or exactly the same as last year, in spite of the large increase in area. The yield per acre of PEAS is estimated at 14·7 cwt., or practically the same as last year, but the acreage was much smaller and the total production of 53,000 tons shows a reduction of 11,000 tons.

The yields per acre and total production of corn are given in the table both in terms of weight and of measure. When further information is received as to the natural weight of this year's crops the figures may require revision.

Over most of the country the bulk of the hay was secured in good condition before the spell of showery weather which set in about the middle of July. The yield per acre of SEEDS HAY is estimated at 29·8 cwt., which is exactly the same as last year and $1\frac{1}{3}$ cwt. above average. Most counties had average or over average crops, very good yields being obtained in the eastern counties. The estimated total production of 2,353,000 tons is 209,000 tons less than in 1925. The total production of MEADOW HAY is, however, estimated at 4,776,000 tons, or 238,000 tons more than last year, the yield per acre of 21·9 cwt. being $\frac{3}{4}$ cwt. heavier than in 1925 and a similar amount above average. Meadow hay crops were lighter than usual in the extreme north-western counties of England and in several Welsh counties. The total production of both kinds of hay is estimated at 7,129,000 tons, or 29,000 tons more than in 1925.

The estimate of the hop crop is given below. The estimates of the potato and root crops will be issued later.

Produce of Hops.—Preliminary statement showing the estimated total production of hops in the years 1926 and 1925, with the acreage and estimated average yield per statute acre in each county of England in which hops were grown; and the average yield per acre of the ten years 1916-25.

NOTE.—Over the total area of hops in England the yield per acre this year is estimated at 13 cwt. This is $\frac{1}{2}$ cwt. less than last year, but is $1\frac{1}{2}$ cwt. above the average of the ten years 1916-25. Well over average crops were picked in each county, but in the Weald of Kent the yields were relatively poor as compared with other districts, and hardly reached the ten years' mean for that area. East Kent obtained a crop $2\frac{1}{2}$ cwt. per acre above average and in Mid Kent the yield was $1\frac{1}{4}$ cwt. above the decennial mean, the yield in the whole of Kent being rather over $13\frac{1}{2}$ cwt. per acre, or 1 cwt. above average. In Hampshire a yield of nearly 14 cwt. per acre was obtained, or 3 cwt. above

PRODUCE OF HOPS.

Counties, &c.	Estimated Total Produce		Acreage returned on June 4		Estimated Average Yield per Acre		
	1926	1925	1926	1925	1926	1925	Average of the Ten Years 1916-25
	Cwt.	Cwt.	Acres	Acres	Cwt.	Cwt.	Cwt.
Kent: East..	**53,000**	63,000	**3,496**	3,693	**15·2**	17·1	12·7
Kent: Mid	**78,000**	88,000	**5,259**	5,418	**14·8**	16·2	13·6
Kent: Weald	**82,000**	101,000	**6.941**	7,150	**11·8**	14·2	11·9
Kent: Total, Kent ..	**213,000**	252,000	**15,696**	16,261	**13·6**	15·5	12·6
Hants	**14,400**	13,000	**1,034**	1,045	**13·9**	12·3	10·9
Surrey	**2,200**	2,200	**177**	179	**12·5**	12·2	9·9
Sussex	**31,000**	28,000	**2,384**	2,413	**13·2**	11·6	10·9
Hereford	**49,000**	40,000	**4,166**	4,186	**11·7**	9·5	9·2
Worcester	**21,000**	19,000	**2,032**	2,059	**10·4**	9·3	9·6
Other Counties*	**1,400**	950	**110**	113	**12·5**	8·4	7·7
TOTAL	**332,000**	355,000	**25,599**	26,256	**13·0**	13·5	11·6

* Salop, Gloucester, and Berkshire.

the ten years' mean, while Sussex with about 13¼ cwt. per acre had a crop about 2¼ cwt. above average. The western counties picked crops of 11¾ cwt. per acre in Hereford and nearly 10½ cwt. in Worcester, the former being 2½ cwt. and the latter ¾ cwt. above the ten years' averages. Kent had a crop nearly 2 cwt. per acre smaller than in 1925, but in every other county yields were heavier than last year.

The total production is estimated at 332,000 cwt., or 23,000 cwt. less than last year, but 64,000 cwt. above the average production of the ten years 1916-25. Kent produced 213,000 cwt., or 64 per cent. of the total, against 252,000 cwt., or 71 per cent. of the total, in 1925.

LICENSING OF STALLIONS UNDER THE HORSE BREEDING ACT, 1918.

THE complete figures now available for the licensing year ended October 31, 1926, show that the decline in the number of stallions licensed in England and Wales under the Horse Breeding Act, 1918, has continued, but that the rate of decrease is somewhat lower than in preceding years. The total number of licences issued for the service season of 1926 was 1,608, as compared with 1,849 in 1925, and 3,816 in 1921. It is noteworthy that the percentage of decrease on the previous year's figures is not so large in the case of Shire and other heavy stallions as amongst the breeds of light horses and ponies.

Service Season	1921	1922	1923	1924	1925	1926
Shires	2,463	2,174	1,634	1,195	953	829
Other heavy horses ..	636	591	486	424	350	324
Light horses (including po ies)	717	714	641	591	546	455
Totals	3,816	3,479	2,761	2,210	1,849	1,608

In 58 cases applications for licences were refused by the Ministry. An appeal against the refusal of a licence was lodged under paragraph 12 of the Regulations in six cases, and three of the appeals were successful.

It is satisfactory to note that the number of cases of infringement of the Act reported to the Ministry is very few. During last season only three unlicensed stallions were reported on the road. Proceedings were taken by the police in two cases and one conviction obtained. There were, in addition, seven licensed stallions reported as travelling unaccompanied by licences.

TABLE I

PEDIGREE STALLIONS *i.e.*, Stallions entered or accepted for entry in the recognised stud book of their breed	BREEDS, HEAVY					BREEDS, LIGHT									BREEDS, PONY AND COB							TOTAL
	Shire	Clydes-dale	Suffolk	Perche-ron		Hackney	Thoro'-bred	Arab	Clevel'nd Bay	Welsh Roadster	Hunter	Y'rkshire Coach	Am'ric'n Trotter		Welsh	Fell	Dales	Polo and Riding	Shetland	Welsh Cob	Dart-moor	
Licensed	797	117	139	41	—	95	136	20	5	1	4	2	—	—	27	22	13	20	17	52	1	1,499
Refused	32	3	5	4	—	5	4	—	—	—	—	—	—	—	—	—	—	—	—	2	—	55
Applications	829	120	144	45	—	100	140	20	5	1	4	2	—	—	27	22	13	20	17	54	1	1,554
NON-PEDIGREE STALLIONS *i.e.*, Stallions not entered or accepted for entry in a recognised stud book	TYPES					TYPES									TYPES							
	Shire	Clydes-dale	Suffolk	Perche-ron	Others	Hackney	Thoro'bred	Arab	Clevel'nd Bay	Welsh Roadster	Hunter	Y'rkshire Coach	Am'ric'n Trotter	Others	Wolsh	Fell	Dales	Polo and Riding	Shetland	Welsh Cob	Others	
Licensed	32	5	—	—	22	13	2	3	—	—	1	—	2	4	1	2	4	2	—	13	3	109
Refused	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Applications	32	5	—	—	22	13	2	3	—	—	1	—	2	4	1	2	4	2	—	13	4	110
Total licensed	829	122	139	41	22	108	138	23	5	1	5	2	2	4	28	24	17	22	7	65	4	1,608
Total refused	32	3	5	4	—	5	4	—	—	—	—	—	—	—	—	—	—	—	—	2	1	56
Total applications ..	861	125	144	45	22	113	142	23	5	1	5	2	2	4	28	24	17	22	7	67	5	1,664

TABLE II

BREED	Number of Stallions Licensed.	Number of Refusals.	Percentage of Refusals	Disease								
				Roaring	Whistling	Sidebone	Ringbone	Cataract	Shivering	Bone Spavin	Stringhalt	Poor Physique
PEDIGREE Shire	797	32	4·0	6	11	6	3	3	2	1	—	—
Suffolk	139	5	3·6	1	2	1	—	—	1	—	—	—
Percheron	41	4	9·8	—	—	2	1	—	—	*1	—	—
Clydesdale	117	3	2·6	2	—	—	—	—	—	—	1	—
Thoro'bred	136	†4	2·9	—	2	—	—	1	—	1	—	—
Hackney	95	†5	5·3	1	1	—	—	—	—	‡1	1	1
Welsh Cob	52	2	3·8	—	—	2	—	—	—	—	—	—
NON-PEDIGREE Pony and Cob	25	1	4·0	—	—	—	—	—	—	1	—	—
		56		10	16	11	4	4	3	5	2	1

* Also affected with sidebone.
† Inclusive in each case of one stallion refused on previous year's examination.
‡ Also affected with whistling.

Stallion owners in possession of licences for the year ended October 31, 1926, are reminded that these licences expired on that date and should have been returned to the Ministry. Applications for renewals, as well as for new licences, should be made as early as possible on forms which may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W. 1.

HINTS ON THE MARKETING OF EGGS

THE following is a reproduction of Marketing Leaflet No. 3, recently issued by the Ministry :—

EGGS SHOULD BE MARKETED FRESH

Collect Eggs at Least Once a Day.—Eggs deteriorate rapidly under broody hens or in summer heat ; frost may crack the shell.

Store Eggs for Market in a Clean, Cool, Dry Place away from Odorous Material.—Eggs have a porous shell ; they are quickly tainted if stored near paraffin, cheese, oranges and other strong-smelling goods. The ideal temperature for an egg store is

from 40° to 50° Fahr. Dampness causes mould growths in the

Market Weekly: More Frequently if Possible.—Eggs may pass through many hands before reaching the consumer; get them to market at the earliest possible moment.

Never Hold Eggs; Treat Your Market Fairly.—To hold eggs for higher prices and then sell them as fresh, or to mix preserved eggs with new laid, is not playing the game.

Always Candle Eggs from "Stolen Nests."—Eggs from "stolen nests" are probably stale and may be rotten. Similarly, infertile eggs removed from the incubator are **not** new laid; addled eggs are unfit for human consumption. The sale of eggs unfit for food is an offence under the Public Health Acts.

You are Better Placed for Supplying New Laid Eggs than the Foreigner: Don't Fritter this Advantage Away.

EGGS SHOULD BE MARKETED CLEAN

Keep Nests Clean and Dry.—Fresh, dry, short straw is the best nesting material; hay is often strong in scent and holds the damp. Never use mouldy hay. Damp stains eggs.

Clean Hen Eggs with Damp Cloth.—Avoid washing hen eggs; this destroys the bloom and impairs keeping qualities.

Wash Duck Eggs.—Duck eggs, if dirty, should be washed clean immediately after collection; a "rub over" is not sufficient.

Keep Stained Eggs at Home.—Stained eggs never look "new laid" and spoil the appearance of a consignment.

Dirt is a Poor Trade Mark and a Bad Advertisement.

EGGS SHOULD BE WELL PRESENTED

Make Consignments Uniform.—Grade your eggs as far as possible. (See Ministry of Agriculture's Marketing Leaflet No. 1.) Mis-shapen, double-yolked and undersized specimens should be used at home. Never "top" a consignment.

Don't Mix Duck and Hen Eggs.—This spoils the market for both. Many buyers of hen eggs do not want duck eggs. Better prices can often be obtained for duck eggs when sold apart. Breakages are more frequent in mixed consignments.

Use Suitable Packages and Dry, Clean Packing Material.—Display your eggs in a basket, case, or other container that shows them to advantage. Stained or damaged fillers and flats spoil appearance and add to breakage risks. Odourless wood wool is better for packing than straw, and usually dryer.

Brand non-returnable packages with your own mark and the grade of the contents.

A Good Appearance Attracts Buyers.

HINTS ON THE MARKETING OF FOWLS

THE following is a reproduction of Marketing Leaflet No. 4 recently issued by the Ministry :—

Market Your Birds at the Right Stage.—Market chickens while they are chickens ; don't keep them until the cockerels have grown combs and spurs and the pullets have started to lay. Surplus birds of light breeds, such as Leghorns, are best sold as petits poussins or " asparagus " chickens.

Study Market Demand.—For example, the best trade for—

Petits poussins is in March and April.
Asparagus chickens is from April to June.
Spring chickens is from April to July.

Send only Well-Conditioned Birds.—Thin birds are not wanted on the market. Unfinished birds carry an undue proportion of bone and offal to flesh and are of inferior quality.

Sell by Weight and Quality.—This is fairer to all concerned than sale by the head and gives a better indication of market values.

IF YOU MARKET DRESSED FOWLS—

Fast them before Killing.—The fasting period should be from twelve to twenty-four hours ; fasting empties the crop and intestines and retards subsequent decomposition.

Kill by Dislocating the Neck—except for cold-storage purposes, when sticking is preferred. When dislocating the neck, make a clean and ample break to allow the blood to drain into the neck from the carcass. When killing by sticking, pierce the brain immediately the artery is severed.

Rough Pluck.—This should be done as soon as the bird is killed. Feathers come out better while the carcass is hot, and there is less risk of tearing the skin. Leave the feathers on the head and half-way down the neck.

Sort the Feathers.—While plucking, sort the feathers into : white body feathers ; coloured body feathers ; quills. White feathers are worth at least twice as much as coloured feathers.

Stub Thoroughly.—Keep the stubs (pin feathers) away from other feathers.

Singe.—Methylated spirit gives a clean flame and does not discolour the skin. The flame from a gas ring is equally suitable.

Clean.—Clean the beak and vent. This not only helps appearance, but improves keeping qualities. Scrub the legs clean.

Shape and Cool.—Shape in accordance with the requirements of your market, while allowing the carcass to cool as rapidly as possible.

Grade.—Grade your consignments ,as far as practicable, according to size, quality and colour of flesh. (See Ministry of Agriculture's Marketing Leaflet No. 2.)

Pack.—Pack systematically and use attractive and, if possible, non-returnable packages.

Brand.—Brand non-returnable packages on the outside with your own mark and with the class, grade, number and net weight of the contents.

The Better the Care, the Better the Product, the Better the Demand.

* * * * * *

DECEMBER ON THE FARM

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),

Agricultural Organizer for Derbyshire.

Seasonal Operations.—There are few field operations of which it cannot be said that they are better performed in some month other than December ; but inasmuch as it is not always possible to complete all autumn operations by the end of November, there is generally some ploughing and sowing to be done in the closing month of the year. As a time for sowing some farmers omit December altogether, preferring to wait until January for an opportunity to complete the drilling of their area of winter oats and wheat. Good crops, however, do sometimes follow sowings that have been made just before Christmas, although as a rule germination does not take place for several weeks after the seed has been put into the ground. Indeed, when the soil temperature is below 40° F., as it is during the middle of winter in a normal season, the seed merely lies dormant.

Fortunately weeds can make little or no growth at cold winter temperatures, and, if disturbed when unable quickly to regain hold of the soil, their vitality is thereby reduced. Light land farmers in the eastern counties make use of this principle in completing the eradication of weeds of the couch and twitch class, keeping the weeds on the surface and stirring them when opportunity permits. On stronger soils in humid districts this method is inapplicable, and in these circumstances more reliance may be placed on double ploughing, or at least the use of a good skim coulter on a plough fitted to turn a deep furrow.

Repeated ploughing during the winter is sometimes advocated as a means of reducing the ravages of wireworms. So far as is known the only manner in which ploughing can affect this

pest in winter is by exposing it to birds; and if that is the main object in view, then the best method of ploughing is to lay a furrow towards each ridge in turn, rather than the customary method of gathering and casting and completing each land before setting another ridge. Wireworms, however, are often blamed for losses that are more rightly attributable to other pests, such as wheat bulb fly, frit fly, and cutworms, which do not, like wireworms, persist in the same field for two or three years. Wireworms are also blamed for loss of plant in young corn when the real cause may be soil acidity. This, however, is most likely to be the case in corn following broken-up sour pasture. Some of the troubles encountered in obtaining a plant of mangolds or in preventing the plant from being taken may, however, be reduced—according to the advice of advisory entomologists—by the application of 10 cwt. per acre of kainit at this time of the year. The method is well worth trying, for this material is not expensive, and, apart from the insecticidal effect, potash is a valuable manurial constituent for mangolds. In fact, on soils where mangolds are grown continuously the quantity of potash removed from the soil may greatly exceed that returned in the dung and artificials, until potash shortage becomes a factor limiting the growth of the crop.

The ploughing of seeds layers for spring corn generally begins about the end of December, and here there are three different methods of procedure. Some farmers prefer first to skim the turf off, work it about to break up the sward, and re-plough at a normal depth some time later. Probably such benefits as may be derived from the additional work here mentioned may be attributed to the exposure of insect ova and larvæ to birds. Ploughing in the narrow set-up seam is still favoured in some districts where broadcasting is practised. For oats this may be advantageous as a help in the prevention of frit fly attack, for the crop can be got in a little earlier than is possible where the land is ploughed flat with the digger with a view to drilling.

Other land operations in December are such as water-furrowing, draining, hedge-brushing and pleaching, and road-mending. Apart from live-stock work about the buildings also, there is frequently plenty of opportunity for filling up time that, owing to weather and soil conditions, cannot well be spent on the land. Overhauling implements and machinery is too frequently left until they are actually required for work. During frosty weather (if any) yard manure should be carted

out on to the ploughed stubbles that are intended for roots and other fallow crops in 1927. The old practice of making a midden of the manure for application in the drills in spring is still too common: the proper place for manure is on or in the soil.

Live Stock.—In districts where ewes lamb early, thought has now to be given to the preparation of the lambing pens, and special care taken of the ewes. A moderate allowance of dry food is considered to be the greatest preventive of troubles with sheep, and of ewes in particular; but ewes must not be subjected to the idea of being fattened up before parturition. In later lambing flocks that are running on grass, a load of roots per hundred ewes per day and a rack of hay may be all the additional food required at present.

Store cattle running out on grass which still has a little pulling are usually left to look after themselves till about the end of this month, after which they need either housing or long fodder, and for this purpose straw has a value greater than it possesses for the production of milk or fat.

Beef Production.—December being the month for exhibitions of fat cattle, problems of beef production will now be widely discussed in farming circles. Feeders are fond of saying that winter-fed cattle leave little or no profit, but are good company and make good manure. Indeed, there is a saying in the eastern counties that two good turnip years will ruin a farmer, the allusion being to the number of stores necessarily fed when yields of roots and straw are abundant. On the other hand, there is the obvious fact that good and progressive farmers continue to practise cattle feeding, and that in some districts, such as the north-east of Scotland, cattle fattened on roots and straw form the principal source of farm income.

If the food consumed by a fattening steer be calculated at the standard prices of feeding stuffs, the bill is apt to exceed the increase in carcass value produced by the ration. Typically, an 8 cwt. bullock, fed to gain 2 lb. live weight per day for 16 weeks, requires a daily ration equivalent to 60 lb. roots, 14 lb. straw, and an average allowance of 7 lb. of concentrates. The cost of the food for the 112 days' fattening is as follows:—

		£	s.	d.
Roots,	**60 lb. × 112 days = 3 tons at 16s.**	2	8	0
Straw,	**14 lb. × 112 days = 14 cwt. at 2s.**	1	8	0
Concentrates,	**7 lb. × 112 days = 7 cwt. at 11s.**	3	17	0
	Total	£7	13	0

From the above gross cost of food may be deducted the manurial values, *viz.*, 3 tons of roots at 3s., 14 cwt. straw at 7s. per ton, and 7 cwt. of cake and meal at, say, £2 per ton, total £1 8s. 0d. This leaves the net cost of food at £6 5s. 0d. If the steer cost £18 (45s. per cwt.) he must, when fat and weighing 10 cwt., realise at least £24 5s. 0d. (48s. 6d. per cwt., or 10s. 7d. per stone) to pay for his food only. Very frequently, however, the above-mentioned allowance of concentrates is greatly exceeded without corresponding increase in rate of fattening; in this case—if the roots and straw are charged for at the standard prices (the price at which nutriment can be bought in the form of meals)—the cattle account shows a considerable loss.

Although fattening cattle cannot as a rule be made to show a profit on the home-grown foods they consume, and the labour, etc., they absorb, the difficulty is to find an alternative. Corn cannot be grown without straw, and arable land requires the organic matter which the indigestible residues of straw contain. The straw can be returned to the land without having been first offered to cattle; but the manurial value of straw is only about one-sixth of its standard food value, so that if possible the latter must be realized. Roots are not indispensable, but where not available less straw may be fed: even where silage is substituted a greater proportion of the straw grown must be used merely as litter. This difference—the realization of the *nutritive* value of straw when fed with roots—is generally not taken into account when considering the question of substituting the root crop.

Baby Beef.—Since 1921 visitors to the Smithfield Show have been familiar with baby beef cattle, which until then were largely regarded as an American fancy. The possibility of making a profit on the production of this class of meat, however, has been demonstrated in experiments carried out by the Ministry of Agriculture for Northern Ireland and by the Herts. Institute of Agriculture. This branch of animal husbandry, unfortunately, does not appear to be likely to solve the arable farmer's problem of making a profit on his winter fattening operations, unless he is willing to become a rearer as well as a feeder of cattle. Even then it has not been shown that baby beef cattle can be used for the consumption of large quantities of rough fodder and to trample down straw in a covered fold yard. Some who have tried fattening very young stores under such conditions have found them very subject to foot troubles. Baby beef production seems to be

more applicable to dairy farmers who are seeking alternatives to increased milk production, or as a way of reducing their scale of milk producing operations.

In the issue of this JOURNAL for December, 1925, Mr. Hunter-Smith described the Herts. experiments. Briefly, seven Dairy-Shorthorn cross steers attained an average live weight of 9¼ cwt. at the age of 16 months. They had been kept indoors all the time, but had received only 25 gallons of new and 55 gallons of separated milk during rearing. The "cake" allowance did not exceed 8 lb. and the total cost of food per head was estimated at about £25.

In the Irish experiments, of which there were a number in the years 1922-24, the calves were similarly pail-reared, but ran out of doors from spring till the end of October. To this date they had made a moderately good daily gain of 1½ lb., so that they weighed 3 cwt. in October. After being taken indoors they received a ration of turnips and hay and an allowance of equal parts of oats and linseed cake, beginning at 3 lb. and increasing to 6 lb. per head per day. On this they made an average daily gain of 2 lb., so that their live weight on May 26 was 7 cwt. The cattle were then 13½ months old, and when sold by auction made £23 10s. 0d. per head. A similar lot of cattle, that had received the same rearing, but only turnips and hay during the winter, made £13 10s. 0d. per head. The baby beef lot had consumed additional oats and linseed cake costing £4 11s. 10d., so that the return on this extra food was £5 8s. 2d.

NOTES ON MANURES FOR DECEMBER

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Waste Limes.—If lime products have to be purchased from a distance it frequently happens that good quick lime is the cheapest form on account of the relatively low transport cost. In many districts, however, there are available waste limes which may be well worth the attention of farmers in the immediate neighbourhood. These substances are wastes and residues from manufacturing processes and usually consist of chalk (in some cases with a certain amount of slaked lime) and a considerable amount of water. According to the water content they may be slimes, pastes, or comparatively dry solids. As a rule the wetter grades are worth little more than cartage, but if means have been adopted to get rid of a large

part of the water a charge is made to cover this cost and their transport radius becomes wider. The usefulness of some of these products as sources of chalk for the land has been established. Of these may be mentioned :—

(1) *Waste Lime from Sugar Beet Factories.*—This contains roughly 36 per cent. of chalk, 8 per cent. of organic matter and 45 per cent. of water, but the composition, and particularly the water content, varies considerably. If exposed to the air it loses water and weathers down and can then be applied to the land. As beet will not thrive in an acid soil this source of chalk is worth the attention of farmers in the neighbourhood of a factory.

(2) *Waste Lime from Paper Works.*—Large quantities of quick lime are used in paper works, and the residues appear as wet chalk. In five samples of this material taken from the dump heaps Prof. Hendrick* found that the content of chalk ranged from 37 to 52 per cént., and water content from 38 to 50 per cent. When allowed to crumble down and used at such a rate as to provide the customary dressing of carbonate of lime it proved very suitable for farm purposes.

(3) *Lime Mud from Alkali Works.*—A product of this type was investigated by Prof. Gilchrist,† who found that it powdered on drying and was quite useful as a source of chalk. It contained from 60 to 70 per cent. of carbonate.

Dressings of the moist waste chalks will be fairly heavy in order to provide enough carbonate per acre. Four tons of a 50 per cent. grade would be a normal application. Standing in heaps allows some of the water to get away, and if the broadcast dressing is exposed to frost on the land this helps to break it down. A distinction should be drawn between waste limes as mentioned and similar by-products which have been dried and obtained in a fine sowable condition and of higher grade (75 per cent. or more of carbonate of lime). These materials fall into the same class as ground limestone and can usually be valued on the basis of their analysis.

Certain waste limes contain impurities which are injurious to crops. Gas lime, now seldom available, and the carbide residues from acetylene gas manufacture are cases in point. A period of exposure either in the heap or on the land will serve to get rid of the poisonous substances, so that winter application on land which is not to be cropped till spring would be advisable in using such materials.

* *Trans. Highland and Agric. Soc. of Scotland*, 1914.
† *Armstrong College Bull.*, No. 12.

Ashes as Manure.—Although as much organic matter as possible should be returned to the soil, it is not practicable to do this in the case of such materials as weed seeds from threshing, hedge trimmings, runners of perennial weeds, and sometimes the stalks of kales and cabbage. These are usually burnt; their organic matter and nitrogen are lost in the process, and an ash remains which contains their mineral constituents. Small-holders and gardeners generally recognize the value of plant ash and take steps to preserve it from loss. On the farm, however, its collection would often not be worth the labour involved, though there are cases when its manurial value can be realized with little extra expense. The composition of the ash varies considerably according to the nature of the original material, but the most prominent fertilizing constituent is potash. The ash of hedge trimmings, threshing waste and wood contains about 11 per cent. of potash; valued on this basis it should be worth about 33s. per ton, but in view of the fact that it is less easy to handle than a potash salt this valuation is rather too high. Most of the potash is present as carbonate, and is very soluble in water; hence if plant material is burnt in large heaps an attempt should be made to protect the ash from rain if it cannot be applied at once. The fluffy nature of bonfire ashes makes them rather unpleasant to distribute, and this difficulty can be got over by mixing the ash with superphosphate. When small fires are made in the field it is desirable to spread the ashes without delay or over-manured patches will result. Once spread the valuable constituents of the ash are safe, as they are retained in the soil.

It is noteworthy that coal ashes have a much poorer analysis than wood or vegetable ashes, and as a rule contain less than 1 per cent. of potash. Experiments at Rothamsted have shown that their fertilizing value is negligible.

Organic Manures.—Much of the nitrogen applied in winter is given as organic manures, for owing to their comparatively slow decomposition there is little risk of loss of nitrate during the winter months, especially on retentive soils and where a crop is occupying the land. Organic manures have certain characteristics in common. They are chiefly regarded as sources of nitrogen, although some, such as fish meal and meat meal, contain considerable amounts of phosphate as well. Their content of potash is negligible. Their action is rather slow, for the nitrogen must pass through a series of putrification and nitrification changes, and the phosphate is insoluble

in water. In the case of the more bulky types, of which heavy dressings are given, a certain mellowness of soil results from their application. There is, perhaps, less chance of injury to the crop arising from their unskilful use than in the case of the chemical fertilizers, although seedlings may suffer if they are in contact with the more active forms when the first rapid fermentation is in progress. Their action is gentle, steady and prolonged rather than forcing, and is supposed to result in even growth and high quality. In many cases residual effects are obtained, the amount depending on the rate of application and being greatest with the slower-acting types. Their active nitrogen is generally valued rather higher than the same element in the mineral form, and the composition of organic manures is more variable than that of the ordinary artificial fertilizers. Wherever possible an analysis should be obtained before purchasing, and it should be borne in mind that on low-grade products the transport charges will raise the cost per fertilizing unit quite appreciably.

Organic fertilizers fall into two broad classes. (1) The first comprises commodities which have an extended market and whose content of nutrients is usually stated. Fish meals, meat meals, dried blood, guanos, and rape cakes are cases in point. Moreover, the raw organic materials may be put through manufacturing processes to improve their physical condition and solubility; and additions of potash salts may be made, thus producing mixed fertilizers with a proportion of soluble constituents. (2) The other section contains wastes and residues which may be available locally, such as feathers, rabbit flick, and so forth, the condition and state of purity of which may be very variable.

The activity of the nitrogen in certain organic manures, such as dried blood and rape cake, is almost equal to that of sulphate of ammonia; fish meal and meat meal are also fairly active, but the majority of organic manures and practically all the waste materials are rather resistant. They should be applied well before the crop which they are intended to benefit, and may be used with advantage as winter dressings. On account of their soil improving qualities and steady lasting action organic, manures are much used for hops, fruit, and market-garden work, and in view of the value of these crops the slight extra cost of some of the high-grade organic fertilizers is no great drawback. For farm purposes, however, the endeavour is to provide the necessary organic matter as dung or

crop residues, and if this is done the need for plant food can be met by the proper use of mineral fertilizers, whose effects under these conditions are generally more rapid, while they are quite as effective as the same amount of plant food supplied in the organic form.

PRICES OF ARTIFICIAL MANURES

NOTE —Unless otherwise stated, prices are for not less than 2-ton lots f o.r. in towns named and are net cash for prompt delivery.

Description	Average price per ton during week ending November 10				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	..	12 10	12 15	12 15	16 5
Sulphate of ammonia— Neutral (N. 20 6%)	11 16*	11 16*	11 16*	11 16*	11 5
Calcium cyanamide (N. 19%) ..	9 8*	9 8*	9 8*	9 8*	9 11
Kainit (Pot. 14%)	3 2	2 15	2 17	2 16	4 0
Potash salts (Pot. 30%) .. .	4 17	..	..	4 10	3 0
„ (Pot. 20%)	3 12	3 0	3 9	3 3	3 2
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51½%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 34%)	..	..	3 8§	..	..
„ (T.P. 30%)	..	3 2§	3 3§	3 6§	2 2
„ (T.P. 28%)	..	2 11§	..	..	..
„ (T.P. 26%)	..	2 7§	..	..	..
„ (T.P. 24%)	..	2 2§	2 3§	2 11§	2 1
Ground rock phosphate (T.P.58%)	2 10¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 6	..	3 9	3 5	1 10
„ (S.P. 33%) ..	..	..	3 6	..	..
„ (S.P. 30%) ..	3 0	2 12	3 2	2 18	1 11
Bone meal (N. 3¾%, T.P. 45%) ..	8 10	8 5	8 10	8 0	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 0†	6 10†	5 15	5 10	..
Burnt lump lime	2 0	1 12*a*	2 0*b*	2 1*c*	..
Ground lime	2 7	2 1*a*	2 9*b*	1 15*c*	..
Ground limestone	..	..	1 10*b*	..	..
Ground chalk	..	1 9		1 5*c*	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W R. and S.R. London Stations the cost to purchasers is 55s. per ton. For the finer grade (80% through standard screen of 14,400 holes to the square inch) the price at London is 2s. 6d. per ton more than for the coarser grade.

a Delivered to Hull.

b Delivered to Liverpool area.

c Delivered in 4-ton lots to London.

MONTHLY NOTES ON FEEDING STUFFS

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The Feeding Value of Treated Sawdust.—Since the discovery that sawdust, treated with acids by appropriate means, yields a certain proportion of fermentable sugars, attempts have been made to prepare in this way a product suitable for animal feeding. An investigation of a product of this nature has been carried out at Massachusetts Agricultural Experiment Station, and the results have been published in *Dairy Science.** The method of treatment of the product investigated consisted in treating sawdust by heat at 120 lb. pressure with dilute sulphuric acid, this being followed by neutralization with lime and partial evaporation. The resultant product consisted of a dark brown powdery meal, possessing a sweet odour and woody flavour. The investigation of this product was directed towards determining its composition, palatability, digestibility, and feeding value for milk production. The samples received for analysis were derived from either Douglas Fir sawdust or Eastern White Pine, and the moisture present varied from 4·06 to 7·50 per cent. On a dry-matter basis, the average analyses were as follows :—

	Protein	Ether extract	Fibre	N.-free extract	Ash
Douglas fir	0·29	1·58	46·25	49·34	2·55
Eastern white pine ..	0·48	3·47	47·45	45·51	3·09

The product is therefore largely carbohydrate in character, there being present a considerable amount of sugar. The ether extract consisted largely of resinous materials, and the ash was largely composed of calcium sulphate. The palatability tests showed that all the cows refused the product when fed alone, but that up to 5 lb. could be fed without ill effects if mixed with the grain ration. The digestibility tests were carried out with sheep, there being 18 digestion trials in all. These showed that approximately one-third to two-fifths of the total dry matter was digested, and approximately two-thirds of the nitrogen-free extract. The digestibility of the crude fibre was extremely variable, ranging from nil to 18 per cent. On a net energy basis it was estimated that Eastern white pine sawdust treated by this method was equal in value to one-half its weight of average meadow hay, whereas the Douglas fir product was valueless.

* "The Composition, Digestibility, and Feeding Value of Hydrolyzed Sawdust": J. G. Archibald, *Jour. of Dairy Science*, vol. ix, p. 257.

The value for milk production was estimated by an 11 weeks' feeding trial carried out with six mature milking cows, maize starch being used for comparison. Owing to the small number of cows used, no definite conclusions were arrived at, but the results indicated that some benefit was derived from the sawdust. From an economic standpoint the conclusion was reached that the use of this product, under the present conditions of supply and cost of carbohydrate concentrates, was uneconomic, but the suggestion is put forward that under conditions of economic distress resulting in a shortage of feeding stuffs this product might be of use in partial replacement of cereal grains and starchy by-products. The general conclusions arrived at in this investigation agree with findings obtained by the writer of this article and Prof. H. A. D. Neville in an investigation carried out by them on a product of similar nature some 13 years ago.

The Effect of Fat in the Ration on the Fat-percentage of Milk.*—Much work has been carried out by various investigators to ascertain to what extent the composition of milk can be influenced by feeding, but the results obtained have been of such a conflicting character that our knowledge of the subject cannot be said to have been materially advanced. The contribution to our knowledge afforded by the publication of this investigation is therefore very welcome to dairy farmers. The primary object of the investigation undertaken by Nevens, Alleman, and Peck was to study the effect of rations, high in oil content, upon the composition of the milk, and particularly on the butterfat content. Rations low in oil content and high in oil content were fed in alternate periods. Four series of trials were carried out in all, and as the result of these experiments the following conclusions were arrived at :—

(1) The percentage fat content of milk can be materially increased by the feeding of rations high in oil, compared with rations low in oil but furnishing an equal amount of digestible nutrients.

(2) The increase can be induced by feeding ground earthnuts or linseed, or oils derived from these seeds.

(3) The increase is attributed to the oil itself and not to a so-called specific effect of the feeding stuff.

* W. B. Nevens, M. B. Alleman, and L. T. Peck: *Jour. of Dairy Science*, vol. ix, p. 307.

DESCRIPTION	Price per qr. s. d.	Price per qr. lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv per 100 lb	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British	—	—	12 18	0 14	12 4	72	3 5	1·83	9·6
Barley, British malting ..	—	—	12 10	0 11	11 19	71	3 4	1 78	6·2
„ „ feeding ..	—	—	9 0	0 11	8 9	71	2 5	1·29	6·2
„ Canadian No. 4 Western	34 0	400	9 10†	0 11	8 19	71	2 6	1·34	6·2
„ Persian	33 0	„	9 5	0 11	8 14	71	2 5	1·29	6·2
„ Russian	35 0	„	9 17	0 11	9 6	71	2 7	1·38	6.2
Oats, English, white	—	—	9 7	0 12	8 15	60	2 11	1·56	7·6
„ „ black and grey	—	—	9 0	0 12	8 8	60	2 10	1·52	7·6
„ Scotch White	—	—	10 0	0 12	9 8	60	3 2	1·70	7·6
„ Irish Black	—	—	8 10	0 12	7 18	60	2 8	1·43	7·6
„ Canadian No. 2 Western	32 9	320	11 10	0 12	10 18	60	3 8	1·96	7·6
„ „ No. 3 „ ..	31 9	„	11 2	0 12	10 10	60	3 6	1·87	7·6
„ „ feed	29 3	„	10 5	0 12	9 13	60	3 3	1.74	7·6
„ American	22 0	„	7 13‖	0 12	7 1	60	2 4	1·25	7·6
„ Argentine	28 9	„	10 2	0 12	9 10	60	3 2	1·70	7·6
„ Chilian	28 9	„	10 2	0 12	9 10	60	3 2	1·70	7·6
Maize, Argentine	35 0	480	8 3	0 11	7 12	81	1 11	1·03	6·8
Beans, English winter	—	—	9 10	1 8	8 2	66	2 5	1·29	20
Peas, „ blue	—	—	17 0*	1 5	15 15	69	4 7	2·45	18
„ „ maple	—	—	14 10	1 5	13 5	69	3 10	2·05	18
„ Japanese	—	—	28 9†	1 5	27 4	69	7 11	4·24	18
Dari, Bombay	—	—	12 5	0 13	11 12	74	3 2	1·70	7·2
Rye, homegrown	—	—	8 0	0 14	7 6	72	2 0	1·07	9·1
Millers' offals—									
Bran, British	—	—	7 0	1 4	5 16	42	2 9	1·47	10
„ broad	—	—	8 0	1 4	6 16	42	3 3	1·74	10
Middlings, fine, imported ..	—	—	9 15	0 19	8 16	69	2 7	1·38	12
„ coarse, British ..	—	—	8 17	0 19	7 18	58	2 9	1·47	11
Pollards, imported	—	—	7 2	1 4	5 18	60	2 6	1·07	11
Meal, barley	—	—	11 0	0 11	10 9	71	2 11	1·56	6·2
„ maize	—	—	9 10	0 11	8 19	81	2 3	1·20	6·8
„ „ germ	—	—	9 7	0 17	8 10	85	2 0	1·07	10
„ „ gluten feed ..	—	—	8 12	1 3	7 9	76	2 0	1·07	19
„ locust bean	—	—	8 0	0 9	7 11	71	2 1	1·12	3·6
„ bean	—	—	12 10	1 8	11 2	66	3 4	1·78	20
„ fish	—	—	19 10	3 15	15 15	53	5 11	3·17	48
Maize, cooked flaked	—	—	11 0	0 11	10 9	85	2 6	1·34	8·6
Linseed									
„ cake, English, 12% oil	—	—	12 10	1 13	10 17	74	2 11	1·56	25
„ „ „ 10% „	—	—	12 5	1 13	10 12	74	2 10	1·52	25
„ „ „ 9% „	—	—	11 15	1 13	10 2	74	2 9	1·47	25
Soya bean „ 6% „	—	—	11 15*	2 7	9 8	69	2 9	1·47	36
Cottonseed cake, English, 5½%„	—	—	7 2	1 8	5 14	42	2 9	1·47	17
„ „ Egyptian, 5½% „	—	—	6 12	1 8	5 4	42	2 6	1·34	17
Decorticated cottonseed meal, 7% oil	—	—	9 15	2 7	7 8	74	2 0	1·07	35
Coconut cake, 6% oil	—	—	8 15	1 7	7 8	79	1 10	0·98	16
Ground nut cake, 6% oil ..	—	—	7 5	1 12	5 13	57	2 0	1·07	27
Decorticated ground nut cake, 7% oil	—	—	11 15*	2 8	9 7	73	2 7	1·38	41
Palm kernel cake, 6% oil ..	—	—	7 5	1 0	6 5	75	1 8	0·89	17
„ „ „ meal, 6% oil	—	—	7 15	1 0	6 15	75	1 10	0·98	17
„ „ meal, 2% oil ..	—	—	6 10	1 1	5 9	71	1 6	0·80	17
Feeding treacle	—	—	6 0†	0 9	5 11	51	2 2	1·16	2·7
Brewers' grains, Dried ale ..	—	—	7 0	1 1	5 19	49	2 5	1·29	13
„ „ „ porter ..	—	—	6 10	1 1	5 9	49	2 3	1·20	13
„ „ Wet ale ..	—	—	0 16	0 8	0 8	15	0 6	0 27	4·8
„ „ „ porter ..	—	—	0 12	0 8	0 4	15	0 3	0·14	4·8
Malt culms	—	—	7 0†	1 10	5 10	43	2 7	1·38	16

* At Hull. † At Liverpool. ‖ At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of October and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 per ton. The food value per ton is therefore £9 per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 11s. 0d.; P_2O_5, 2s. 8d.; K_2O, 3s. 0d.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch equivalent	Protein equivalent	Per ton	
	Per cent.	Per cent.	£	s.
Barley	71	6·2	9	10
Maize	81	6·8	8	3
Decorticated ground nut cake	73	41·0	11	15
„ cotton cake	71	34·0	10	0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2·31 shillings, and per unit protein equivalent, 1·62 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm	
	Per cent.	Per cent	£	s.
Wheat	72	9·6	9	2
Oats	60	7·6	7	11
Barley	71	6 2	8	14
Potatoes	18	0 6	2	2
Swedes	7	0 7	0	17
Mangolds	7	0·4	0	17
Beans	66	20 0	9	5
Good meadow hay	31	4 6	3	19
Good oat straw	17	0·9	2	1
Good clover hay	32	7·0	4	5
Vetch and oat silage	13	1·6	1	12
Barley straw	19	0·7	2	5
Wheat straw	11	0·1	1	5
Bean straw	19	1·7	2	6

MISCELLANEOUS NOTES

The Agricultural Index Number

THE general level of the prices of agricultural produce during October was 48 per cent. above pre-war, or practically the same as in each of the months June to August, but seven points lower than in September. The rise in the general index number for September was, however, exceptional, owing to the contract price for milk being much above the usual summer level.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921 :—

Month	Percentage Increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	180	71	67	60	71	58
February	164	75	63	61	69	53
March ..	146	73	59	57	66	49
April ..	145	66	54	53	59	52
May ..	115	69	54	57	57	50
June ..	105	64	49	56	53	48
July ..	103	67	50	53	49	48
August	122	68	52	57	54	49
September	113	59	52	61	55	55
October	82	61	50	66	53	48
November	74	63	51	66	54	—
December	71	61	55	65	54	—

Live Stock

Live stock generally sold at slightly lower rates than in the previous month. Fat cattle showed a reduction of 1s. 4d. per live cwt., and the index figure was reduced by 4 points to 35 per cent. above pre-war. Fat sheep at 11d. per lb. estimated dressed carcass weight showed no change in price on the month, and the index figure remained unaltered at 52 per cent. above the base years, a figure which has remained constant for the past three months. Little change has been noticeable in the prices of fat pigs, porkers averaging 13s. 9d. per stone of 14 lb., or the same as in September, while baconers declined by 4d. per stone to 12s. 6d. The index figure in the latter case declined by 5 points to 74 per cent. above pre-war as compared with 70 per cent. a year ago, but prices of porkers at 81 per cent. above pre-war show a rise of 10 points on the year.

Dairy cattle further advanced in price on the month, the average rise being about 8s. per head, but as this increase was relatively less than in October of the base years, the

index number shows a slight reduction on the figure for September. The percentage increase of 38 for October shows a considerable decrease on the percentages of 48 and 62 ruling in the corresponding months of 1925 and 1924 respectively. Store cattle and store sheep became cheaper ; the index figure for store cattle was 3 points lower at 25 per cent. above pre-war and that for store sheep 16 points lower at 47 per cent. The sharp fall in the index figure for store sheep was due rather more to the increase in price in October, 1911-13, than to the fall in price in October. Store pigs were about 2s. per head cheaper than in September, but as this decline corresponded with the decrease in October in the base years the index figure was unchanged on the month at 142 per cent. above pre-war.

Grain

Prices of wheat declined during September and advanced during October, but the monthly average showed an advance of only 1d. per cwt. to 11s. 4d. ; the index figure, however, rose by 3 points to 53 per cent. above pre-war as there was a slight decrease in price in the corresponding months of the base years. Barley sold at 5d. and oats at 4d. per cwt. less than in September and as in each case an increase of 2d. per cwt. was shown in the same period of the base years the index figures show comparatively large reductions, from 50 to 42 per cent. in the case of barley and from 25 to 17 per cent. for oats above pre-war. Barley averaged 12s. 1d. and oats 8s. 1d. per cwt.

Dairy and Poultry Produce

The contract price of milk in October averaged 1s. 4d. per gallon as compared with 1s. 3d. in September, but as this increase of 1d. was much less than the increase which occurred in the base years 1911-13 the index number shows a sharp reduction from the September figure of 100 per cent. to 60 per cent. above pre-war, or the same as in each of the months May to August. The percentage increase in the corresponding month of 1925 was 74 per cent. and for 1924 was 81 per cent. Butter at an average quotation of 1s. 9¼d. per lb. was only slightly dearer than in September but with a greater increase in the base period the index number has fallen 4 points. Cheese, however, showed no change in price, but as in the base years a rise of 2s. 6d. was shown the index figure is lower at 30 per cent. above 1911-13 as compared with 34 per cent. in September. The seasonal rise in egg prices continued during October and as the increase was relatively greater than in the base years, the index figure moved up 16 points to

68 per cent. above 1911-13. A year ago the percentage increase above pre-war was 90 per cent. and eggs then averaged 2s. 7¾d. per dozen as compared with 2s. 4d. during October this year.

Other Commodities

Of all the commodities taken into account in the agricultural index, potatoes have shown the greatest price movement during October, the average of the wholesale prices having advanced from £5 3s. 6d. per ton in September to £6 10s. in October. At the end of the month prices were about 20s. per ton above the monthly average. The rise in price caused the index figure to advance by 41 points to 81 per cent. above pre-war. Hay prices scarcely varied from those quoted in September, but as there was a slight increase in the base years the index figure shows a decline of 3 points. Apples and pears were both slightly dearer in October, whilst vegetable prices showed considerable variation. Brussels sprouts, cauliflowers, and cabbage were dearer, and celery and onions cheaper than in September. Vegetable prices generally were only 27 per cent. above pre-war, carrots and cauliflowers being relatively the dearest at 54 and 47 per cent. respectively, while cabbage were cheaper by 8 per cent. than in October, 1911-13.

Index numbers of different commodities during recent months and in October, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	Oct.	Oct.	July	Aug.	Sept.	Oct.
Wheat	69	40	73	69	50	53
Barley	103	44	17	52	50	42
Oats	47	33	33	33	25	17
Fat cattle	48	48	40	43	39	35
Fat sheep	93	62	59	52	52	52
Bacon pigs	37	70	83	79	79	74
Pork pigs	41	71	84	83	81	81
Dairy cows	62	48	38	37	39	38
Store cattle	41	32	33	33	28	25
Store sheep	112	69	82	63	63	47
Store pigs	29	88	139	139	142	142
Eggs	89	90	33	49	52	68
Poultry	67	48	52	55	46	48
Milk	81	74	60	60	100	60
Butter	73	71	56	56	56	52
Cheese	39	77	78	43	34	30
Potatoes	154	53	21	11	40	81
Hay	– 3*	1	8	11	9	6
Wool	112	46	23	24	31	32

* Decrease.

Export of Breeding Stock

NUMBER and declared value of animals, living, for breeding, exported from Great Britain and Northern Ireland in the three months ended September, 1926, compared with the corresponding period in 1925. (From returns supplied by H.M. Customs and Excise.)

Country to which exported	July to September, 1926		July to September, 1925	
	Number	Declared value	Number	Declared value
CATTLE		£		£
Argentina	55	7,737	95	18,152
Brazil	72	4,838	12	1,982
Costa Rica	7	165	0	0
France	0	0	20	349
Germany..	0	0	23	794
Spain	12	1,030	0	0
Uruguay	9	1,020	1	260
Falkland Islands ..	7	314	1	52
Irish Free State ..	1,087	14,556	1,194	14,424
Kenya Colony	7	594	0	0
Union of South Africa .	0	0	17	2,867
Other countries	5	654	10	573
Total of Cattle	1,261	30,908	1,373	39,453
SHEEP AND LAMBS				
Argentina	157	3,883	197	4,678
Chile	7	203	3	235
Netherlands	3	75	4	64
Russia	0	0	205	3,454
Spain	21	405	0	0
Uruguay	70	2,664	13	195
Falkland Islands .	0	0	20	730
Irish Free State ..	357	1,085	1,543	4,426
Other countries	7	119	16	497
Total of Sheep and Lambs	622	8,434	2,001	14,279
SWINE				
Argentina	9	140	0	0
Brazil	1	7	6	242
Latvia	1	32	9	66
Poland	4	230	0	0
Russia	0	0	31	1,088
Spain	17	425	0	0
Channel Islands ..	6	40	0	0
Irish Free State ..	232	1,356	209	802
Union of South Africa ..	0	0	21	515
Other countries	22	597	17	612
Total of Swine	292	2,827	293	3,325

The Egg and Chick Distribution Scheme

THE main object of this scheme is to provide facilities whereby cottagers, allotment holders, and others engaged in poultry keeping on a small scale may obtain stock of good productive capacity from approved breeders in their district. The following figures show the distribution during the past two seasons :—

Year	Stations	Eggs	Chicks	Duck eggs	Ducklings
1925	.. 353	9,371 doz.	4,778 doz.	150 doz.	119 doz.
1926	.. 324	11,480 "	5,831 "	72 "	46 "

Thirty-nine counties adopted the scheme in 1926, eleven of which established none but trap-nested stations, as compared with only five last year. It is estimated that 70 per cent. of the total stock distributed came from trap-nested birds. All the above figures relate to England and Wales. Of a total of 240 stations established in English counties, 175 were for trap-nested stock only.

The scheme will again come into operation in most counties next January, the only important alteration for the forthcoming season being the exclusion from the scheme of non-trap-nested stock, with the exception of breeding pens of table breeds specially approved for the purpose of improving the table qualities of the poultry in a district. In view of the almost universal use of the trap-nest by breeders, little difficulty is anticipated in obtaining the requisite quota of station-holders possessing a sufficient number of stock birds with authentic trap-nest records. More detailed information with regard to the operation of the scheme in 1927 is given in a memorandum obtainable on application to the Secretary of the Ministry, 10 Whitehall Place, London, S.W. 1.

A Record Milch Goat

AT the Dairy Show held at the Royal Agricultural Hall, Islington, from October 19 to 22, the challenge certificate and cup for the best goat were won by Ch. Didgemere Dream Q**, which was first by inspection as well as in her recorded class. The Ministry's Recorder was present when this animal was milked on the evening of June 30 and the morning of July 1, the yield, *viz.*, 19 lb. 14 oz., or 1·94 gallons, constituting a record for a 24-hours' test. Didgemere Dream weighed 202 lb. on October 16, and has yielded 4,236 lb. 4 oz., *i.e.*, 413·3 gallons of milk, or nearly 21 times her weight, during the recorded year to October 1.

Farm Workers' Minimum Wages.—Meetings of the Agricultural Wages Board were held on October 25 and November 15 at 7 Whitehall Place, London, S.W. 1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages and proceeded to make the following Orders carrying out their decisions:—

Buckinghamshire.—An Order to come into operation on November 1 continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until further notice. The minimum rates are in the case of male workers of twenty-one years of age and over 31s. per week of 50 hours in summer and 48 hours in winter, with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays, and in the case of female workers of eighteen years of age and over 6d. per hour for all time worked.

Cambridgeshire and Isle of Ely.—An Order to come into operation on November 1 continuing the minimum and overtime rates of wages at present in force for male and female workers during the winter period until December 31, 1926. The minimum rates are in the case of male workers of twenty-one years of age and over employed wholly or mainly as horsemen, cowmen, or shepherds 37s. per week for the hours necessary for the performance of the customary duties of workers so employed, and in the case of other male workers 30s. per week of 48 hours, with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays. In the case of female workers of eighteen years of age and over the minimum rate is 5½d. per hour, with overtime at 7d. per hour.

Cheshire.—An Order to come into operation on November 1 continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until October 31, 1927. The rates are in the case of male workers of twenty-one years of age and over 35s. per week of 54 hours, with overtime at 9d. per hour, and in the case of female workers of eighteen years of age and over 6d. per hour for all time worked, with the proviso that in the case of female workers engaged for milking the sum payable for each meal, that is, each occasion on which the worker visits her place of employment for the purpose of milking, shall be not less than 6d.

Essex.—An Order to come into operation on November 1 continuing the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers until April 30, 1927. The minimum rates are in the case of male workers of twenty-one years of age and over 30s. per week of 50 hours in summer and 48 hours in winter, with overtime at 9d. per hour, and in the case of female workers of twenty-one years of age and over 6d. per hour for all time worked.

Warwickshire.—An Order to come into operation on October 31 continuing the existing minimum and overtime rates of wages for male and female workers until October 29, 1927. The minimum rates are in the case of male workers of twenty-one years of age and over 30s. per week of 50 hours in summer and 48 hours in winter, with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays, and in the case of female workers of eighteen years of age and over 5d. per hour, with overtime at 6d. per hour on weekdays and 7½d. per hour on Sundays.

Yorkshire, North Riding.—An Order to come into operation on November 1 varying the minimum and overtime rates of wages

at present in force for male and female workers. The rates are in the case of male workers of twenty-one years of age and over 33s. per week of 48 hours in winter and 52½ hours in summer, with payment for employment in excess of those hours in attendance on stock at 4d. per hour in the case of workers boarded and lodged by their employer and 8d. per hour in the case of workers not so boarded and lodged, with overtime at 10d. per hour on weekdays and 1s. per hour on Sundays. In the case of female workers of eighteen years of age and over the minimum rate is 6d. per hour for 44 hours; with overtime at 9d. per hour. The rates are to continue in force until further notice.

Yorkshire, West Riding.—An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on November 24 (when the existing rates are due to expire) and to continue in force for twelve months. The minimum rates in the case of male workers living in and hired by the year o half-year range from £85 16s. per annum for foremen to £54 12s. per annum for farm lads. These sums, which include the value of board and lodging, are in respect of a week of 48 hours in winter and 52½ hours in summer, with, in addition, 12 hours per week on weekdays and 3 hours on Sundays to cover work in connexion with the care of and attention to stock. In the case of waggoners and other horsemen, beastmen, and shepherds of twenty-one years of age and over, not living in, the minimum rates for the same number of hours are 42s. per week. For other male workers of twenty-one years of age and over the minimum rate is 36s. per week of 48 hours in winter and 52½ hours in summer. The rates in respect of overtime are in the case of male workers of eighteen years of age and over 11d. per hour on weekdays and 1s. 1d. per hour on Sundays. In the case of female workers the minimum rate for workers of eighteen years of age and over is 6d. per hour for a week of 44 hours, with overtime at 7½d. per hour.

Carmarthenshire.—An Order to come into operation on November 15 continuing the existing minimum and overtime rates of wages for male and female workers until November 14, 1927. The minimum rates are in the case of male workers of twenty-one years of age and over 31s. for a seven-day week of 54 hours, with overtime at 8½d. per hour, and in the case of female workers of eighteen years of age and over 5d. per hour, with overtime at 6d. per hour.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

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Foot-and-Mouth Disease.—Six outbreaks of foot-and-mouth disease have been confirmed since the issue of the November number of the JOURNAL—all in hitherto "clean" areas. A new centre of disease was found at Harmondsworth, Middlesex, on November 4, and a further case of disease was confirmed in that area at Slough, Bucks, on November 13—these two outbreaks having a common origin.

New centres of disease were also discovered at Smarden, Kent, on November 11; and at Lydd, Kent, and Battle, East Sussex, on November 15. So far as can be traced there is no connection between the last three-mentioned cases. A fresh centre was, in addition, discovered at Wacton, near Norwich on November 23.

The above outbreaks bring the total for the year to 196, involving 29 counties and the slaughter of 5,499 cattle, 11,579 sheep, 2,431 pigs. and 7 goats.

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NOTES FOR THE MONTH

Inter-County Clean Milk Competition for England and Wales

In consultation with the Ministry of Agriculture and Fisheries, the British Dairy Farmers' Association have adopted a scheme for an Inter-County Clean Milk Competition with the object of encouraging improved methods of milk production. The competition is open to all Counties in England and Wales; and the "Stapleton" Cup will be awarded to the competing County that, in the opinion of the judges, has made the greatest progress in clean milk production during the competition year, which runs from July 1 to June 30. The first award will be announced at the Dairy Show in October, 1927, for the year ending June, 1927.

The awards will be made mainly on progress shown under the schemes of technical assistance in clean milk education provided by local education authorities and assisted by the Ministry. A number of counties have for several years held clean milk competitions for farmers in their areas, and competitions in the best methods of milking. The Inter-County Competition now established will take into account the results reached in the county clean milk and milkers' competitions for the year, the attendance of farmers at clean milk demonstrations, and the numbers of producers in the county who hold licences for Certified, Grade "A" (T.T.), and Grade "A" milk.

In addition to the award of the "Stapleton" Cup, valuable prizes are offered for the three leading competitors in the Clean Milk Competition of the winning county, together with money prizes, etc., for their head cowmen.

Eighteen counties have provisionally entered the current year's competition, and there is little doubt that a keen contest will ensue. Further particulars may be obtained from the Secretary, British Dairy Farmers' Association, 28 Russell Square, London, W.C. 1.

International Poultry Exhibition

THE Fifty-fifth International Avicultural Exhibition will be held in Paris from February 9 to 14, 1927, in the Exhibitions Park at the Versailles Gate. The exhibits will include fowls, ducks, turkeys, geese, pigeons, rabbits, etc. Exhibits will be admitted into France free of customs duty and into Paris free of octroi duty. Further information with regard to the exhibition may be obtained on application to: Monsieur le Commissaire Général, Exposition Internationale d'Aviculture, 34 Rue de Lille, Paris.

Farm and Small Holdings Settlements of the Ministry

THE history of the Farm and Small Holdings Settlements of the Ministry is dealt with in the Report,* recently published, of the Proceedings under the Small Holding Colonies Acts, 1916 and 1918, and the Sailors and Soldiers (Gifts for Land Settlement) Act, 1916, for the years 1923-24, 1924-25 and 1925-26. In the exercise of its powers under these Acts the Ministry acquired 15 estates, situated in 11 different counties, and having a total area of over 25,000 acres. Of these the Ministry now retains only six [Amesbury, Patrington, Bosbury, Sutton Bridge, Holbeach and Acton Park (Wrexham)] and arrangements have been made for one, the Patrington estate, to pass out of the Ministry's possession in the near future. The remaining nine estates have been disposed of either by transfer to the respective county councils, after subdivision into small holdings, or by sale. In all 4,551 acres have been transferred to county councils and 7,787 acres have been sold or the leases surrendered, whilst 44 acres remain on hand pending disposal and 3,884 acres are let in large holdings to tenant farmers. About 4,630 acres are administered by the Ministry as profit-sharing farms and 4,710 acres are managed as small holdings.

(i) *Patrington Profit-sharing Farm.*—The Report deals very fully with the position of the Patrington estate, one of the two properties managed on a profit-sharing basis. This estate of 2,363 acres, forming part of Sunk Island, about 15 miles east of Hull, was acquired by the Ministry in 1916 on a 99 years' lease from the Commissioners of Crown Lands. Between 50

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and 60 ex-service men and their families have been settled at Patrington, a proportion of the men, when first accepted, being only partially skilled in agriculture and having insufficient capital to enable them to take up the cultivation of small holdings on their own account.

The profit-sharing scheme under which this estate has been carried on provided for the management of the settlement by the Ministry, but any profits, after all working expenses and overhead charges have been met and an allocation made to reserve fund, were to be divided between capital, management and labour in proportion to the amounts charged in respect of these items in the working account.

The first 18 months' working showed a substantial profit, but in each subsequent year farming operations have been carried on with considerable loss. Bad seasons and the agricultural depression were doubtless responsible for some part of the annual losses, but the Ministry did not anticipate the continuance of these losses on such a heavy scale during the last two or three years. The Ministry realized that the estate account was bound to show a balance on the wrong side, since it could not expect to receive an economic return for the capital outlay of over £67,000 on the provision of new and improved houses, buildings and other equipment. But the recurring excess of cash payments over cash receipts on the ordinary working of the farm was viewed with such concern that the Ministry, with Treasury sanction, entrusted to Mr. W. Gavin, C.B.E., the task of investigating the whole position at Patrington and ascertaining whether there was any likelihood that the settlement could by any possible means be carried on without loss in the future.

Mr. Gavin's very able report is printed in full as Appendix II to the volume recently published, and will be of interest to anyone who has followed the fortunes of the Ministry's land-settlement activities in general and of the Patrington venture in particular. After an exhaustive inquiry Mr. Gavin came to the conclusion that, even if existing liabilities were written down to equal the value of existing assets, the farming of this estate as one unit would result in an average annual loss of about £4,000. The Minister gave this matter anxious and careful consideration and regretfully came to the decision that it was impossible to ask Parliament to continue to meet the losses which would accrue from year to year if the settlement were farmed by the Ministry indefinitely.

Negotiations were opened with the Commissioners of Crown Lands and it has been arranged that the lease of the estate shall be surrendered at Lady Day, 1927. Steps are being taken to mitigate any hardship which might be caused to the settlers as a result of the Ministry's decision. The removal expenses of any men who find work in other parts of the country are being defrayed and every effort is being made to secure information concerning vacant posts in agricultural employment for those whose future is uncertain.

(ii) *Amesbury Profit-sharing Farm.*—The other profit-sharing settlement managed by the Ministry is Amesbury, the history of which makes a pleasing contrast with that of Patrington. This settlement has a total area of 2,427 acres, of which about two-thirds are owned by the Ministry and the remainder leased from the War Department and a private owner. The profit-sharing farm comprises 2,264 acres, the remaining area being let as small holdings.

During the first year of the settlement a large profit of £7,968 was made and £1,647 was distributed among the settlers in accordance with the profit-sharing scheme. The Exchequer received £1,770, equivalent to a dividend of 13½ per cent., on the farming capital invested. The four following years, 1920-21 to 1923-24, all resulted in losses of varying degrees, but it may fairly be said that these losses did not arise from the ordinary working of the farm, but were due to the severe fall in agricultural values. The year 1924-25 resulted in a small profit and 1925-26 in a small loss; this means that, taking the last two years together, farming results have enabled the settlement practically to meet overhead charges for interest on capital and headquarters administration after paying the full farm rent to the estate account and fully providing for the depreciation of implements and for the remuneration of the director.

The success of the Amesbury settlement has been achieved during a period of acute agricultural depression. At the same time the cultivation of the land has been steadily improved during the Ministry's tenure and is now at a higher level than it has been for many years, with the result that it is maintaining a permanent population of workers and their families about 50 per cent. larger than before the Ministry entered into occupation.

(iii) *Sutton Bridge Small Holdings.*—When acquired in 1919, the Sutton Bridge estate had a total area of 6,542 acres. The estate is situated to the south-west of the Wash, and comprises

what is recognized to be some of the finest agricultural land in the country.

As the leases of the large farms on the estate have fallen in, it has been the Ministry's policy to subdivide the farms into small holdings, for which there is a considerable demand from a desirable class of applicants. Up to the present 166 holdings have been created and equipped, the total area subdivided being 2,539 acres—an average of between 15 and 16 acres per holding. Treasury authority has already been obtained for the development of a further 1,400 acres which come into hand at Lady Day, 1927.

The total capital expenditure incurred on the estate since its acquisition amounts to about £100,000, but the net call on the Exchequer has been about £60,000 only, the balance being met from the proceeds of the sale of surplus town properties at Sutton Bridge.

The value of land settlement in definitely settling new families on the land which they occupy is shown in the population returns collected by the Ministry. The total resident population on the area subdivided into small holdings up to April 1, 1926, was 494, whereas prior to subdivision this area had a resident population of about 220. Thus in a period of five or six years the population of this part of the estate has more than doubled.

(iv) *Holbeach Small Holdings.*—The Holbeach estate, comprising about 1,000 acres leased from the Crown, is within easy reach from the Sutton Bridge estate, and these two settlements are managed by one director. The whole of the Holbeach estate is divided into just over 80 holdings, the population of which on April 1, 1926, was 364 persons, as compared with a population of 99 resident on the estate prior to its development.

(v) *Bosbury (Buchanan Trust) Estate.*—The Bosbury (Buchanan Trust) estate is managed by the Ministry under the provisions of the Sailors and Soldiers (Gifts for Land Settlement) Act, 1916. The land was generously given by the late Mr. R. Buchanan for the settlement of ex-officers, and, although not acquired under the Small Holding Colonies Acts, it is administered in most respects in the same way as the settlements acquired under these Acts.

When the trust was accepted by the Ministry the estate was admittedly in a low state of repair and cultivation. Consequently a large expenditure had to be incurred by the Ministry in improving the condition of the buildings and clearing and reclaiming the land from a semi-derelict state.

The improvement of the estate has undoubtedly resulted in considerably increased production. The estate has been divided into 15 holdings, averaging about 40 acres, and the population has been doubled in the course of the six years since 1920.

Farm Produce Agents in New South Wales

IN March last, the Parliament of New South Wales gave assent to an Act providing for the registration and regulation of farm produce agents, the Act to come into operation on a date to be fixed later. The term "farm produce agent" is defined in the Act as "any person who as an agent for others carries on the business of selling, on commission or for any fee or reward, farm produce consigned to him by others."

The main provisions of the Act are as follows:—All such agents are required to be licensed. An applicant for a licence must furnish a bond for £500, or some such other form of security as may be prescribed. Licences are renewable annually upon payment of a fee of 20s.

The registrar appointed for carrying out the provisions of the Act has authority to inspect the books of any farm produce agent, and is entitled to communicate the result of any such inspection to the specific client concerned.

An account of every sale must be rendered within seven days. All moneys received by the agent in excess of the amount paid or advanced to his client must be paid into a trust account, which account may not be applied in payment of any other client's account, and the amount due in respect of any sale shall be paid within fourteen days of such sale.

An agent is not allowed to purchase any farm produce for himself, either directly or indirectly, unless he has previously obtained the written consent of the consignor, in which case commission is not chargeable on the transaction.

Penalties may be imposed under the Act—(*a*) for the destruction of any marketable farm produce by an agent, (*b*) for misrepresentation of produce, (*c*) for spreading false rumours in order to enhance or decry prices, or (*d*) for reselling produce, wholesale, at an enhanced price, within three miles of the original market.

A registered co-operative company may be deemed not to be a farm produce agent.

Poultry Houses

THE importance of providing adequate accommodation for poultry is now generally recognized; no poultry-keeper can expect his birds to be really profitable unless they are properly housed. Scientific principles of poultry housing, however, are still very imperfectly understood in some quarters, and, with the object of supplying information on the subject, the Ministry recently published a practical manual entitled *The Planning of Poultry Houses* (Miscellaneous Publications, No. 47), containing working drawings of a 14 ft. laying house, a lean-to laying house, a Lancashire cabin, a double breeding pen, a Sussex ark, a "backyarder's" house, and a Philo coop; together with instructions concerning such points as situation, floor area, perching capacity, ventilation, light, internal fittings, materials, floors, roofing felt, water and runs. Both plans and letterpress have now been revised and an explanatory diagram and other useful matter added to the second edition of this booklet, which will shortly be issued, and copies of which may be obtained direct from the Ministry at 10, Whitehall Place, S.W. 1, price 1s. post free.

Green Manuring*

AT the present time, when the cost of making farmyard manure runs high, it is well to consider the alternative methods of obtaining and using organic manure. From time to time instances are quoted in which green manures have been wonderfully successful in increasing or maintaining the fertility of the soil. Yet there is very little collective information on the subject with regard to its general bearing on British agriculture. Some attempt to rectify this position and bring together as much information as possible on the subject was made at a Conference on Green Manuring, held at Rothamsted on December 10 last.

The general effect of the papers of the practical farmers and the subsequent discussions seemed to show that green manuring in this country is divisible into three main types: (1) That practised in systems of high farming, (2) that found in systems of low farming, and (3) the specialized cases. Three very clear examples of these divisions were given by Mr. Wm. Bruce, Mr. H. Upcher, and Mr. H. Inskip.

* See also articles on this subject in this JOURNAL, Vol. XXIX, May and June, 1922.

Mr. Bruce, a Lothian farmer and flock-master of wide experience, produced interesting data concerning the method he has adopted for keeping up the fertility of his own highly farmed soil by the use of various catch-crops. In the Lothian district the practice of green manuring is not carried out to any great extent unless the crops can be utilized in the first place, at any rate in part, as stock food, and only then when the gain in the stock is likely to cover the cost of the seed. An amount which seems to be generally agreed upon in all parts of the country for the cost of seed is in the neighbourhood of 10s. per acre.

Mr. Upcher (Norfolk) showed how on his land green manuring is not merely a matter of maintaining the fertility of the soil, but rather of attempting to make a barren land produce successful crops. His land, consisting chiefly of flint-dust on a porous " dead-lime " subsoil, urgently required the addition of humus. In one particular instance he attempted to meet the need in the following manner: Fish gipps from Yarmouth were first applied to the land. A mustard crop was then taken and ploughed in. Rye was next sown in the autumn and was fed off by sheep in the following spring. Lupines followed, these being ploughed down by August, when mixed kales and turnips were sown. At this stage a complete dressing of artificials was given, and in October rye was drilled across the rows. In the next March ewes and lambs were folded on the field with extra food, and as soon as the folding was over the field was ploughed and sown with barley. This was undersown with giant sainfoin, and at harvest yielded a heavy crop, 15 sacks per acre of good quality head corn being produced for sale. Mr. Upcher is of the opinion that on very light land the Norfolk four-course rotation results in too much ploughing and not sufficient dunging, and that another crop, such as a green manuring crop, could be introduced with great success.

The farming practice of Mr. Inskip (Biggleswade) afforded an excellent example of the specialized case. His soil was mostly an unretentive gravel requiring frequent additions of humus, and the conservation of moisture in the soil was, therefore, a problem which he had to consider very closely. He solved it with considerable success by the aid of deep ploughing, frequent hoeing, dunging, and systematic green manuring. His intensive rotation was: (1) Potatoes, with dung and green manure; (2) peas, mangold seed and miscellaneous crops; (3) wheat or oats. After twenty years' experience he had found that broad-leaved clover sown under the corn was the best green manuring

crop for his needs. An experiment carried out by himself showed that the yield of potatoes was increased three tons per acre after green manuring by red clover.

From the experimental results produced, and the opinions of the many practical men—including Mr. H. Drewett (Chichester), Dr. H. J. Page, Dr. Voelcker, and others—engaged in the Conference, it would appear that green manuring is one of those practices which are capable of considerable development under some conditions of agriculture in this country. In the tropics, where quick growth is obtained, and where stock are generally few in number, it is of the very greatest importance to producers of crops. In parts of America it makes possible the maintenance of the existing systems of husbandry, while in parts of Germany and Central Europe generally it is practised with great regularity over wide areas of productive land.

There is no doubt that the sharp variations in soil and climate, and consequently in the farming systems, which are to be found in the relatively small area of Great Britain add considerably to the difficulty of propounding and using any means to fertility which involves the growing of an extra crop in the rotation. There, nevertheless, appears to be a possibility in the opportune use of green manuring in one form or another which few of us can afford to pass by without careful consideration.

"Bolting" in Mangolds and Sugar-Beet

THE following note has been communicated to the Ministry by Dr. J. A. Voelcker: The "bolting," or running to seed, of mangold and sugar-beet crops is not an uncommon occurrence, and though the cause is not definitely known, and while, undoubtedly, it is more prevalent in some seasons than in others; the tendency to "bolt" is generally associated with early sowing. It is possible also that "bolting" depends to some extent on the variety and source of the seed.

Of late the subject has become of some importance in connexion with sugar-beet cultivation, inasmuch as the factories have advised the exclusion of any roots that have "bolted."

Having grown, during this past season, at the Woburn Experimental Farm, crops of mangold and sugar-beet on the same land, and some of the plants having in each case "bolted," I thought it would be of interest to take, from the crops, representative samples of sound and "bolted" roots, and to compare them in respect of their analytical composition.

(*a*) *Mangolds.*—The seed was sown on the drills on May 8, the variety being "Lord Warden"; manures were applied before sowing, and a top-dressing of nitrate of soda given on July 5. The number of "bolted" plants was by no means large, and on November 2 four roots of each kind were selected for analysis.

(*b*) *Sugar-beet.*—The seed was sown on the flat on May 20, the manures being applied before sowing. Comparatively few plants "bolted," and the "bolting" did not occur in the early stages, but in the late period of growth only, so that the typical roots selected for analysis were not inferior to the others, but indeed weighed more. The roots were selected on November 2.

The four lots of samples were then analyzed and gave the following results :—

	MANGOLDS.		SUGAR-BEET.	
	Sound Roots.	*"Bolted" Roots.*	*Sound Roots.*	*"Bolted" Roots.*
	per cent.	per cent.	per cent.	per cent.
Water	90·07	90·27	75·40	77·65
Sugar	6·20	4·80	17·50	16·50
Fibre	·60	·74	·96	1·16
Mineral Matter ..	1·22	1·30	·69	·88
Weight of Roots	lb. oz.	lb. oz.	lb. oz.	lb. oz.
(washed & trimmed)	15 6	16 3	6 4	7 6

In the case of the mangolds the differences in water and in mineral matter were immaterial; the fibre, however, was rather more in the "bolted" roots, which showed a loss of 1·4 per cent. in sugar.

The "bolted" sugar-beet, while giving over 2 per cent. more water and slight increases in fibre and in mineral matter, showed a reduction of 1 per cent. only in the sugar content.

It would not appear, therefore, that the quality of "bolted" sugar-beet is so much lessened as to necessitate the exclusion of such roots from what is dispatched to a factory, at least when the roots, as in the above instance, have not visibly suffered in size.

THE DORSET HORN SHEEP

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THE Dorset Horn Sheep, a native of Dorset, Wiltshire, Somerset, and the Isle of Wight, is a very old breed. The original type, as it once existed in Dorset, was smaller than the present one, the size of which has been obtained by a cross with the larger Somerset Horn breed. Claridge, in his *Survey of Dorset*, 1793, comments on this crossing; and it is not improbable that the old type had practically disappeared by this date.

Before Australasia was stocked with Merinoes the English cloth manufacturers relied largely for their wool supplies on the Southdown sheep; and at one time this breed appeared likely to drive the Horn sheep from the chalk hills. But, although the Downs sheep actually dispossessed the native breed from the higher chalk ridges, it was never displaced in western Dorset, where the chalk gives place to the less elevated and more productive pastures on lias and oolite. In fact, since the Horn breed has been improved in grazing character and wool, it has reconquered much of its former territory; and there are probably many more flocks of Dorset Horns now than existed half a century ago. The interests of the breed are looked after by the Dorset Horn Sheep Breeders' Association.

Points of the Breed.—Few breeds to-day possess greater uniformity of type than the Dorset Horn. The breed is of a medium size, with white face, legs, and hoofs, and is horned in both sexes, the ram having a singularly long and convoluted horn. The face is rather long and thin and the nostrils are pink. The wool is finer than that of any of the Downs, with the possible exception of the Southdown; of fair density, but of only moderate length. In most of the Down breeds the wool is creamy white and often contains dark fibres, but in the Dorset Horn the colour is a clear white, free from black or brown. The weight of the fleece is 4 lb. to 6 lb. washed, or from 7 lb. to 9 lb. unwashed.

The ram has a bold masculine appearance, and a head of great beauty, with strong and long horns growing well apart on the crown in a straight line with each other, and coming downwards and forwards in graceful curves as close to the face as may be without cutting. The improved breed is straight

and deep in the body, the ribs well arched, the loin broad, and the neck well set on. It is full in the shoulders, without coarseness, and the hind limb is well let down towards the shank. The full deep chest allows room for the heart and lungs, and indicates strength of constitution. The breed is as fine in the bone, compared with the amount of mutton carried, as the best Downs.

Objections.—There should be no spots on the skin or fleece, or markings on the horns, no coarse hair on the legs, and no tendency of the horns to grow back.

Locality of the Breed.—The breed is found principally in west and south Dorset, the Isle of Purbeck, the Isle of Wight, and in the Bridgwater, Crewkerne, and Taunton districts of Somerset. Registered flocks also exist in Sussex, Hampshire, Norfolk, Hereford, Kent, and Lincoln, and are also found in Scotland, the Isle of Man, the United States, South Australia, and New South Wales.

From this list the power of the breed to adapt itself to different conditions and varieties of climate will be realized. In the Isle of Man a silver challenge cup is awarded for the breed at the local show.

Economic Features of the Breed.—The Dorset Horn sheep is distinguished by the remarkable fecundity of the females: 150 per cent to 180 per cent. of lambs may be regarded as common.

Outside the south of England the knowledge which agriculturists possess of this interesting breed appears to be limited to the fact that it will produce twice in the year. Although this fact is true, there is no known system by which it may be done with success. On very good land and with an abundance of concentrated foods it is possible to breed three times in two years from four and six-tooth ewes, but it is a strain on the ewes, should not be attempted with young ewes, and is inadvisable if any effort is being made to maintain and improve a registered flock. The ewes are excellent nurses, extremely hardy, and good folding sheep. The improvement of the breed has not impaired either hardiness or fecundity.

Probably the chief economic quality of the breed lies in the fact that the ewes will receive the ram as early as April or May so that lambs are born in September or October and may be sold for the butcher by Christmas. The usual lambing

Photo] [*Sport and General*

Dorset Horn Ewes.

Dorset Horn Rams.

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time, however, is in November and December, the lambs being sold in February and March. It is safe to say that the Dorset Horn equals any other breed in fecundity, early maturity, and the power of adapting itself to differing localities and varieties of climate.

Annual Sales.—The principal fairs for the sale of Dorset Horn sheep are held at Dorchester on the third Thursday in May and the last Thursday in September. The great annual breeders' show and sale of rams and ram lambs is held at Dorchester on the third Thursday in May.

Management of the Flocks on Upland Arable Farms.—The object in view on the upland arable farms is the production of early fat lamb. The general lambing time for the flock is from November to Christmas. Three crops of lambs are taken and the full-mouth ewes sold with a warranty of soundness in tooth and udder at the May sale. These ewes usually go to the rich lowlands of Somerset, where another crop of lambs is taken, and ewes and lambs fatted together. Defective and poor-type ewes are usually disposed of at the same time.

The flock ewes generally lamb on grass, often on a temporary ley which is due to be broken. For a few days after lambing it is customary to put the ewes into maiden seeds, and from thence to roots. Two-year leys, consisting largely of sainfoin, are common on these upland arable farms, and the ewes are allowed to roam over the second year's seeds during the day, and are folded at night. The lambs are allowed to run forward and are encouraged to eat cake and corn as early as possible. A common mixture consists of equal parts of linseed cake, home-grown oats, and home-grown peas. Clover hay is fed to the ewes and, in the early stages, cake and corn are also given with the object of feeding the lambs through the ewes. Egyptian cotton cake and oats are commonly used for this purpose, but one part of decorticated earthnut cake with two parts of bruised oats form a better mixture. As the lambs begin to eat cake the ration to the ewes is gradually withdrawn.

It is customary to separate the flock when the lambs are young, so that the ewes with wether lambs and those with twins may be given preferential treatment.

On the type of farm in question all lambs except those needed to replenish the flock are sold fat to the butcher; these are never weaned. The flock lambs are usually selected and weaned in April. It is customary to select about 25 per

cent. more ewe lambs than will be actually required for the flock. These are again culled at a later date, sometimes in October, or, if keep is plentiful, they may be kept till the following spring to go out with the draft ewes. On some farms, in selecting ewe lambs for the flock, preference is given to twin ewe lambs with the idea that the fecundity of the flock may thereby be increased. Figures bearing on this point would be of great interest and value.

Roots are followed by folding on rye or winter oats, and mangolds are usually pulled out and thrown about in such folds. Vetches and trifolium follow, and the pastures are relied upon to some extent at this time of the year till aftermaths of clover or sainfoin are available for folding.

The practice of breeding from lambs is seldom adopted on the type of farm in question. The lambing time for the breed, falling in November, makes it unwise to expose an immature sheep to the trials of maturity under the weather conditions which usually prevail. The case of sheep is peculiar among farm animals in this respect, there being practically no choice between lambing at one or two years old. Even on good land and under comparatively sheltered conditions, it is unwise to breed from immature animals if it is desired to perpetuate ample frames and strong constitutions.

It is customary to attempt to get the ewes into good improving condition before the rams are put in, as this is thought to increase the tendency to produce twins. One ram per fifty ewes is the usual allowance, but if ram lambs are used this is reduced, and such rams must not be allowed to run long at a time with the flock.

On this type of second-class arable farm, where the establishment of good permanent grass is difficult and the absence of water in the majority of fields makes grass farming impossible, it will be seen that the qualities of the Dorset Horn breed make it invaluable. Such farms have most keep during the winter when roots are available, the shortest time being in May and June after the roots are finished and before the clover aftermaths are ready. With the Horn breed, the ewes are dry and empty at this time, and the fat lambs being all sold by the middle of April, the head of stock on the farm is also lowest at the time when keep is short.

The writer would like to express his appreciation of the help and courtesy of Mr. J. Dean Smith, Secretary of the Dorset Horn Sheep Breeders' Association, who has given great assistance in compiling these notes.

COMBINED PASTURE AND ARABLE DAIRY FARMING IN SOUTH DEVON

N. S. GRILLS.

Situation.—The writer became tenant of the 70 acre farm here described eight years ago. It is situated in South Devon, eight miles distant by rail from Plymouth, the nearest station on the Southern Railway being about one mile from the farm. Most of the land has a south-east aspect and slopes steeply down to the banks of the River Tavy. The house and buildings are nearly at the bottom of the hill.

Soil.—The soil is mostly a light loam, but 10 acres near the banks of the river are somewhat heavier and more difficult to cultivate, but better land.

Running to the top boundary on the eastern side of the road, which practically divides the holding into two, are some 30 acres of very plain land, 12 acres of which are quite unworkable because of the shallowness of the soil and the deepness of the slopes. The remaining portion of this poor land—18 acres—will not carry grass permanently, but the soil is grateful and easy to cultivate, so that with generous treatment average crops can be secured. Practically all the permanent pasture and one or two arable fields of rather better quality are on the western side of the road. The fields range from three to six acres in area, and are fenced in the typical Devon manner with earth banks surmounted by living hedges. Where the hedge is allowed to grow to a good height shade is provided in the summer and shelter in the winter, but such fences are costly to maintain.

The cropping of the holding is briefly as follows :—

(*a*) 17 acres permanent pasture of good quality, plus 12 acres of rough grazing.
(*b*) 5 acres of market garden.
(*c*) 36 acres available for rotational cropping.

The permanent grass is always grazed and never mown for hay.

The market garden is principally devoted to the growing of fruit and flowers ; about three acres are cropped with apples, plums, and damsons, and undercropped with bush fruit such as gooseberries, black currants, and raspberries and, in some cases, with flowers of the narcissi family. The remaining two acres of open ground are planted with bush fruit, strawberries, and varieties of bulbs not suitable for underplanting.

Of the area available for rotational cropping about one-half is utilized as temporary grass, which is sown to stand for three or four years. Approximately nine acres of corn are grown, chiefly oats and, occasionally, a small area of wheat. The remaining nine acres are largely used for forage cropping and roots; one acre of potatoes for sale is usually included. The first year temporary grass is always mown for hay, with the addition of as much more of the second and third seasons' grass as can be spared.

Stock when Tenancy commenced and the Objects in view.—The holding was taken over at Michaelmas, 1918, and stocked forthwith. The object in view was dairy farming combined with pigs, poultry, and fruit growing. At the commencement of the tenancy the stock on the farm was six dairy cows, four in-calf heifers, four bullocks, which were fattened during the winter, four weaning calves, two horses, and one sow. The holding was very well stocked with winter feed when taken over. It was decided to keep milk records privately at the outset, and the first year's average was well under 500 gallons per cow (South Devons). The cause of this low average was not a question of bad or insufficient feeding, but the inherent poor milking qualities of the herd. These records were considered very unsatisfactory, and methods of management were overhauled so that yields might be improved, and the information obtained from the milk records was used to eliminate the passengers from the herd as soon as possible.

Gradual Evolution of a System of Forage Cropping.—In the spring of 1920 fodder crops were experimented with. Thousand-headed kale was one of the crops grown and gave a very satisfactory yield, an estimated crop of 20 tons per acre being secured. It was singularly fortunate, as in the summer of that year there was an extremely hot and dry period. Land in this locality cannot stand drought, and the pastures were soon burnt brown. The kale proved a great boon; it was fed from the month of August, and if it had not been available the cows would have been without green food. The lesson of the 1920 summer could hardly have been overlooked in farming this type of land, and it was emphasized by the necessity of purchasing a stack of hay during the winter. Several other crops were tried and were distinctly encouraging. The effects of the drought in the summer of 1921, which was worse than that of the preceding year, were again minimized by the arable crops on the holding; and this con-

vinced the writer that a succession of green crops would not only ensure a food supply in dry seasons, but would also enable a larger head of stock to be carried, at the same time reducing the purchase of expensive concentrates to a minimum. It was realized that the season when grass is at its best is a comparatively short one, and, in the absence of a good substitute, concentrates must be used to maintain the yield of even moderate milkers, instead of being reserved for the heaviest milkers only.

No strict rotation of fodder cropping is practised, different seasons bringing different climatic conditions and calling for variations in methods, but the supply of supplementary forage crops is now practically continuous from August until early June.

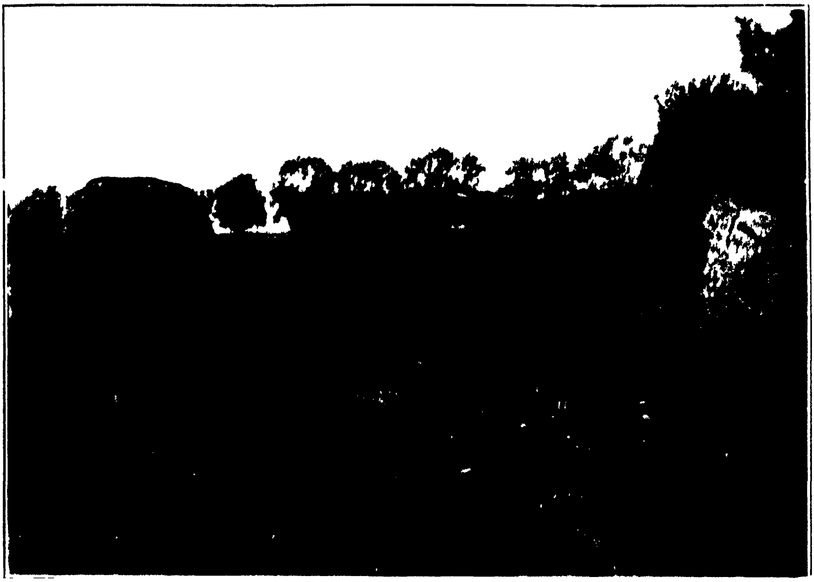
A Typical Succession of Crops.—*Early Spring Crops.*—Immediately after corn harvest, following either winter oats or wheat, from one to one and a half acre of rye and tares are sown, sometimes rye alone. This generally furnishes a supply of green fodder in April. A similar portion is sown with Italian rye grass and trifolium, which forms a successional crop to the rye and usually provides fodder until early June. If the whole of these crops is not required as forage the residue is mown for hay, but in any case these crops allow stock to be removed from temporary pasture in time to permit of a hay crop being taken.

Marrow-Stem Kale and Thousand-Headed Kale.—As the land devoted to the foregoing crops is cleaned, it is cultivated and sown with marrow-stem kale. Care is taken that the land is well consolidated after ploughing at this time of year, so that all possible moisture is available for germination. It sometimes happens that the weather becomes so dry that the prospect of success by seeding is doubtful. In this case another plan is adopted, and marrow-stem kale plants are transplanted from another section, where seed has been drilled earlier in the season. About two acres of kale are drilled in March and April, and roughly two-thirds of this area are devoted to marrow-stem and one-third to thousand-headed kale. The kale crop is found to be one of the most useful crops grown, and is a perfectly safe feed which appears to have no undue laxative tendency, when fed in reasonable quantities, to any type of stock. Marrow-stem is preferable to thousand-headed, especially for pigs, and although frequently described as being tender and liable to damage by frost, this has not been the

writer's experience. Winter weather conditions in this locality are rarely so severe as in the northern parts of the country, but in the winter of 1925-26 severe frosts of unusual duration occurred, and the crop was practically undamaged. In this district, under average farming conditions, a yield of 20 to 30 tons per acre may be expected. It is fed on this holding from October until March, using the marrow-stem first and the thousand-headed last. In the cultivation it is customary to drill the seed to enable extra cleaning to be done. Broadcasting has been tried on several occasions, but drilling is definitely preferred. Kale plants make very slow growth in the seedling stage, and unless the land is very clean the young plants are rapidly choked by the quicker growing weeds. While the plants are small enough to permit the passage of the horse hoe between the rows without causing damage, cultivation is maintained, but the crop absorbs little manual labour, little thinning being done beyond drawing out a few plants for transplanting purposes. The ordinary turnip drill is used for seeding, and the seed is drilled as thinly as possible, *viz.*, about 3 lb. per acre, whilst the width between the rows varies from 20 to 24 in. Although the plants look scanty for a week or two, they rapidly cover the ground and keep the weeds in check once they have passed the slow-growing stage. When necessary, plants are taken from the March and April sowings to plant the land cleaned of rye and trifolium.

Oats and Peas.—A few acres are sown with oats and peas as early as possible in the spring. This crop is available for feeding in July, but is more usually mown for hay when the peas are in flower. It is seeded at the rate of three to four bushels per acre, in the proportion of two of oats to one of peas. Much heavier crops of hay are secured from this mixture than from ordinary grasses, and the cattle appreciate such hay and thrive on it. It is more difficult to harvest than grass, but will stand a fair amount of rain before being ruined. During the bad hay harvest of 1924 a field of oats and peas lay under very bad weather for a considerable time; it was thought that the crop would be useless, but the following winter it was eaten by the dairy cows with relish, and there was little mildew or dust in the stack. It is, however, essential that oat and pea hay should be thoroughly dry before ricking or much mould may be expected in the hay.

Maize.—To supplement the failing pastures towards the end of summer an acre of maize is grown, and the value of this crop can hardly be over-estimated. It is easy to grow,



A Group of In-calf Heifers

A Group of Cows from the Herd

COMBINED PASTURE AND ARABLE DAIRY FARMING IN SOUTH DEVON

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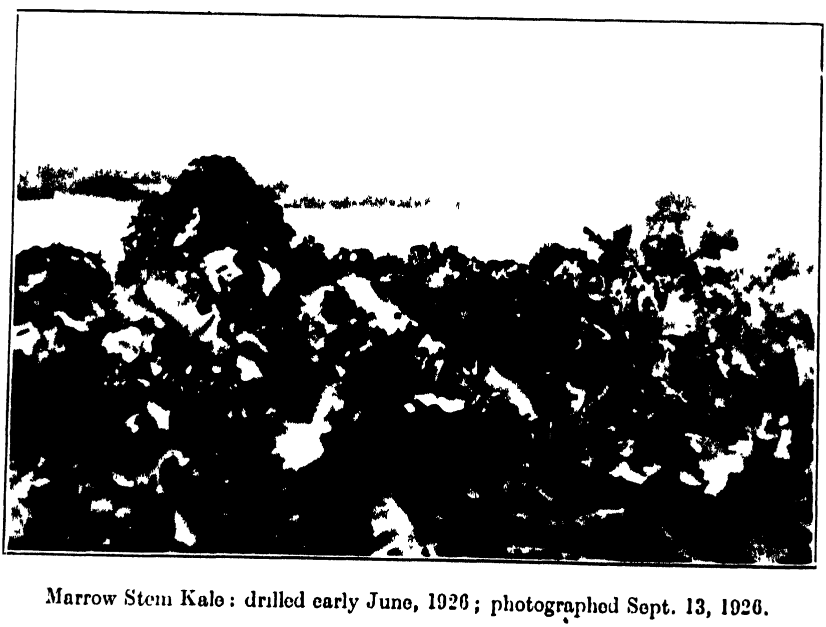
Maize. drilled May 15, 1926, photographed Sept. 13, 1926



Marrow Stem Kale: drilled early June, 1926; photographed Sept. 13, 1926.

produces an enormous bulk of palatable fodder at a time when grass is rapidly losing its most nutritive qualities, and it can be fed to cattle freely without ill-effect. On this farm its cultivation is very similar to that given to the potato crop. A dressing of farmyard manure is always given, and the seed —at the rate of 70 to 80 lb. per acre—is sown in the furrow after the banking plough; and the furrows are then split back to cover the seed to the depth of 2 to 3 in. The rows are placed from 20 in. to 2 ft. apart. As birds are liable to cause damage to the germinating seed, it is usually dressed with a preparation to make it distasteful. When the young plants appear they pass through a dormant period, and at this stage weeds are kept down with the horse hoe if the land is at all dirty; but no hand labour is required if the section selected is reasonably free from weeds. As this crop is susceptible to damage by frost, it is better to delay sowing than to be too early, and the usual time here is about the middle of May. Given warm weather, once beyond the seedling stage, maize grows so rapidly that it effectually chokes out all surface weeds. The variety grown for the past five seasons has been white horse tooth, and, as this has always been satisfactory, no other variety has received a trial. The crop is usually available for use in early August, and in 1925 it was fed daily from August 3 to October 5. The cattle never seemed to tire of it, eating the last load as readily as the first, and there was no waste, although much of it was seven feet high.

Cabbage.—Another crop sometimes grown is the large purple flat-poll cabbage. The seed is sown in a seed bed in the autumn and the plants are transplanted into a portion of the area from which spring forage crops have been removed. It is used as an alternative feed to kale during the winter months, and, being a very hardy plant that will stand considerable dry weather at the time of transplanting, a small area is usually worth while.

Common Turnips.—A small area of common turnips is sometimes sown after the last of the trifolium and rye grass has been cleared. This crop is not greatly favoured, but as a second crop it is sometimes preferable to allowing the land to be unoccupied and so get weed-ridden.

Mangolds.—Early in May about one acre of mangolds is drilled and the crop is treated as well as circumstances permit. A good average crop of 30 to 35 tons is usually secured, and, although it is an expensive item in the rotation, it is found most useful. The roots are stored in a convenient

place, as in the stormy days of winter it is more convenient to get mangolds from a sheltered clamp than to cut marrow-stem or thousand-headed kale in the open field. This practice, however, is not resorted to more frequently than the weather makes necessary, as most of the roots are required for the interim period between the finishing of the kale crops and the feeding of the rye.

Other Crops.—Other crops which have been given a trial, but which have not proved successful, are rape kale and hardy winter greens.

The Rotation.—The rotation practised, if such it can be called, may be said to be a six or seven course, and is roughly as follows :—

First year, Winter oats or wheat.
Second year, Green crops.
Third year, Oats, seeded down.
Fourth year, Temporary grass.
Fifth year, Temporary grass.
Sixth year Temporary grass broken for corn.

This is not strictly followed, as in some instances forage and roots may be grown for two consecutive years. The following table will illustrate the forage cropping of one field in 1924-25. The field is four and a half acres in extent, and was cropped with oats and peas which were mown for hay in July, 1924.

½ *acre*	1 *acre*	1 *acre*	1 *acre*	1 *acre*
Rye sown Sept., 1924, cut April, 1925. Marrow-stem kale drilled May, 1925.	16 lb. trifolium and one bushel Italian rye grass sown Sept., 1924, cut May and June, 1925. Marrow-stem kale drilled on portion cut in May, common turnips on portion cut in June.	Fallow from July, 1924. Maize in May, 1925.	Fallow from July, 1924. Drilled with thousand-headed kale March, 1925.	Fallow from July, 1924. Drilled with marrow-stem kale April, 1925.
		This portion of the field was foul with charlock, etc., and, by fallowing, several crops of seedlings were removed.		

NOTE.—In this season the crop of rye and vetches and flat-poll cabbage was in another field, where an additional cleaning crop was required ; otherwise the whole field would have been cropped in the autumn.

Temporary Pasture.—As indicated, the land is seeded down to temporary ley for three or four years. Wild white clover has always been included in the mixture, but, until recently, only a small percentage of cocksfoot has been sown, and this has tended to become coarse. In 1925, on the recommendation

of the Agricultural Organizer, the mixture was amended as follows :—

Perennial Rye Grass ..	10 lb.
Italian Rye Grass	5 ,,
Cocksfoot	10
Rough-stalked Meadow-grass	1
English Broad Red Clover	2
Late-flowering Red Clover	2
Alsike	
Wild White Clover	

This field has since been cut for hay, and there was an estimated yield of more than two tons per acre despite a dry season.

It is the invariable custom to top dress the maiden seeds with basic slag in the autumn following the harvesting of the nurse crop. More recently, test plots of other phosphatic manures, such as superphosphate and mineral phosphates, have been laid down, but it is too early to give a definite opinion on the results.

Method of Feeding Crops.—The situation of much of the land, which from time to time is under the plough, is, as stated, on a fairly steep hillside, and this makes the carting of dung to maintain fertility a laborious and costly operation, since a single horse and cart can hardly haul 10 cwt. of dung at a load. Further, the number of stock now maintained is greatly in excess of the housing accommodation available, and there is no satisfactory storage pit for manure. Every effort is therefore made to ensure that, as far as possible, the live stock shall act as a walking dung cart. In order to bring temporary pasture into good condition for breaking, it is now the practice to concentrate stock heavily for nearly twelve months on the field that is to be broken. The dairy cows lie out throughout the year except for about a week at calving time, and, with the exception of fattening pigs, young calves and the two horses, all the stock on the holding is at grass all the winter.

Largely owing to the increased amount of home-grown food available, the number of horned stock has been practically doubled. The dairy cows are brought in for milking in the morning and receive their ration of concentrates according to their individual yields ; they are subsequently turned into the grass fields that are to be broken up, where green forage and hay have been distributed, thus ensuring that the land is liberally dunged. A further distribution of forage or hay, or both, is made after the evening milking. The soil is dry

and easily drained, and, although it gets somewhat churned up, this treatment does not prejudice matters when the ley is subsequently broken up. A good crop of corn usually follows, and 100 bushels of winter oats to the acre have been grown. In 1926, following a dry summer, the crop of winter oats was nearly 70 bushels. In feeding the forage crops, care is taken to overlap one crop with the other so that cattle are not suddenly faced with a strange feed. For instance, when commencing to feed kale in the autumn, a start is made before the maize is finished, so that for one week the ration would include part maize and part kale. Under this system only a surprisingly small quantity of fodder is wasted or is trodden under foot. The forage crops are not chaffed, and it is found that the cows consume practically all the marrow-stem stump. All the oats grown are consumed on the holding, the only grain sold being an occasional few sacks of wheat if fit for seed purposes and surplus to the requirements of the poultry.

Manuring of Arable Land.—The only crops grown which receive dung are maize and mangolds. During the remainder of the rotation a balanced mixture, made up of three parts superphosphate, one part sulphate of ammonia, and one part sulphate of potash, is used at varying rates per acre according to the crop; for instance, marrow-stem kale would receive from 4 to 6 cwt. per acre of the mixture according to the writer's judgment of the needs of the crop. In spite of this treatment the fertility of the farm is distinctly improving.

The Present Stocking of the Holding.—The stock carried on the holding at the commencement of tenancy has already been mentioned. At the time of writing it is as follows:—

19 Cows.
1 Stock bull.
5 In-calf heifers.
3 Heifers between 15 and 17 months.
8 Heifers between 9 and 14 months.
2 Heifer calves and a purchased bull calf for stock.
3 Breeding sows.
3 In-pig gilts.
2 Boars, and the further complement of fattening, store and suckling pigs.
2 Horses (unchanged).

Feeding of the Dairy Cows and other Live Stock.—Modern methods of feeding dairy cows according to individual yield have been practised for several years. In spring, when the grass is good and green forage is added, it is not customary to

supplement the ration with concentrates unless a cow is yielding more than three gallons per day. After the end of July, or earlier if pastures fail, supplementary feeding is given where yields are above two gallons. In winter, with the cows at grass, it is the aim to make the first gallon of milk on a daily feed of about 14 lb. of hay and about 56 lb. of kale or other fodder crop; and, whilst oat and pea or vetch hay is being fed, one and a half gallons can reasonably be anticipated without the addition of concentrates. Although this can be taken as the average, no hard-and-fast rule is followed; and the condition of the individual animal, plus any variation in the recorded yield, may lead to an occasional modification. Nevertheless the cows maintain their condition well under such treatment. The general healthiness of the herd, despite exposure to winter weather, is proved by the fact that when tested not a single animal reacted to the tuberculin test. As far as possible, home-grown oats are made to form two-thirds of any concentrated ration feed, and they are balanced by the addition of palm-kernel cake, decorticated earthnut cake or other feeding stuff high in protein value. As far as the other live stock on the farm are concerned, an effort is always made to keep them in a growing and thrifty condition. If the pasturage is short, this is eked out with forage crops or hay when necessary. In a similar manner forage crops like maize and marrow-stem kale are eaten with avidity by the pigs, which are kept growing healthily and sound on their legs by free range and balanced rations.

The feeding of the dairy herd was the subject of cost accounts by the Seale-Hayne Agricultural College in the winter of 1924-25. Estimating the production cost of kale and mangolds at 10s. per ton and hay at £4 per ton, with an average daily yield per cow from November until March of 2·34 gallons, the cost of food alone worked out at 8·2d. per gallon.

The Value of Milk Recording.—It was stated that, for the first year in which milk records were available, the average annual yield was less than 500 gallons. This has been considerably improved. Recording was carried out privately for several years, but the advantages of official records were obvious, and more recently the work has been supervized by the local milk-recording society. By careful feeding and the elimination of passengers, the average yield of milk for the herd during the past three years has been 815 gallons per cow. More than half the herd consists of heifers and second

calvers. The highest individual yield was in 1925, by a cross-bred cow, which gave, after her third calf, 1,366 gallons. She had also given 1,209 gallons with her second calf, living in the open all the year round, and not being pampered. In addition to yield records, testing milk of individual cows for butter-fat content is carried out, the average being about 4·5 per cent.

Breed of Cattle.—The cows are principally of the local South Devon breed. In 1924 a separate herd book was established to encourage the milk side of the South Devons. To be eligible for entry in this herd book, cows must qualify with a yield of 800 gallons in an official milk-recording year, and must pass an inspection committee to ensure maintenance of the features of the breed. A number of cows are now entered in the herd book.

The South Devon is a very healthy, hardy, dual-purpose beast, but is criticised in some quarters on account of its legginess. The ideal aimed at is to produce a more compact animal than is common with the earlier registered South Devons, one closer to the ground, and which, whilst carrying flesh, will produce 1,000 gallons of milk per annum. This alteration is being attempted by the use of dairy bulls as short on the leg as possible, without failing in other breed points. The bull at present in use is the progeny of a 1,000-gallon cow which has been a consistent breeder and milker, and his sire's dam had a record of 1,229 gallons in an official recording year.

Pigs.—A small pedigree herd of Long White Lop-Eared pigs is maintained. The breeding sows run rough at grass throughout the year, and all growing pigs are expected to graze a proportion of their living. The breed appears to be very thrifty, and the sows are excellent mothers. An effort is made to dispose of the best young pigs for stock purposes, but those not sold in this manner are either sold as stores or fattened off.

Poultry.—The Rhode Island Red breed is the only one kept on the farm, and the laying flock consists of about 100 birds. Breeding is not done indiscriminately, but a small selected breeding pen is maintained, in an isolated field, from which all eggs for hatching are obtained. This breed is found to be hardy and prolific, and a satisfactory producer of winter eggs without any pampering beyond the supply of the necessary protein in the food.

EXTERMINATING THE WARBLE FLY IN DENMARK

HARALD FABER,

Agricultural Commissioner to the Danish Government.

AMONG the many pests with which farmers have to contend the warble fly occupies a special position in several respects. Its life history is fairly well known ; it is so big that it is readily seen ; its maggot or grub grows in an easily accessible place, *viz.*, on the back of cattle, just under the skin. The maggot is fairly easily killed, and, as is proved by experiments carried out both in England, Germany, and Denmark, if the maggots are systematically killed in a district, the cattle in the district can be protected against attack, because the warble fly does not migrate to any great extent. It follows from this that it should be possible for farmers, by systematically killing off the maggots over a period of a few years, to rid a whole country of the pest, to their great benefit and that of the trades dealing in hides and leather.

In the issue of this JOURNAL for April, 1921, page 92, the loss to farmers caused by the warble fly was described as "enormous." It is not only that the hides are greatly damaged and lowered in value ; the cattle are worried and restless, milch cows fall off in milk production, and even the meat, after slaughter, is found to be injured. The damage done in 1903, in so small a country as Denmark, was estimated at no less than £275,000.

The maggots grow during early spring and form lumps or boils on the skin, generally along both sides of the spine. When the maggots have reached something like full size, the skin has formed a considerable cavity in which the maggot sits with the point of the abdomen just inside the centre opening of the lump, through which it breathes. When large the maggot can be squeezed out, but this is a tedious proceeding, and besides, the maximum damage has then already been done. Better would it be to kill the maggot in its earlier stage, which can be done by applying various washes or ointments which either kill the grub by poisoning or by suffocating it by shutting out the air. In 1921, the English Ministry recommended a wash made by infusing a powder chiefly consisting of tobacco with an equal quantity of lime, the wash to be applied once a fortnight during spring until May. In Denmark a proprietary hypoderma oil has been found very efficient ; it is applied to the lumps or boils as soon as

they are detected; and the maggots are then killed before they have done any damage worth speaking of.

The difficulty lies in the fact that it is necessary for all farmers to act simultaneously. One farmer may rid his cattle of the pest and so avoid the damage to his cattle. But if maggots are full grown on cattle at a neighbouring farm, the warble fly will reinfect his cattle next year, and he will sooner or later therefore lose interest in the uneven fight. This difficulty is in a fair way to being overcome in Denmark through legislation. Before describing how this has been done it is only right to point out that the conditions obtaining in Denmark make the extermination of the warble fly from the whole country easier than it would be in other countries where the cattle are kept under different conditions. On account of the more severe winters in Denmark, all cattle are stall-fed for about seven months, and are generally taken out to the fields at the end of April. Consequently it is a fairly easy matter to have the cattle treated and inspected before they leave the byres, and legislation has taken this into account.

Danish Laws with regard to Warble Fly.—The first law was passed on March 8, 1923, and made it the duty of every keeper of cattle to rid his cattle of the maggots of the warble fly during the years 1923 and 1924. Every Parish Council was to appoint suitable men who, before April 15, that is, while the cattle were still in the byres, should visit every herd in the parish, unless the owner, before April 1, had sent the Council a certificate from a veterinary surgeon stating that the maggots on his herd had been destroyed. Maggots found in a herd are to be killed at the cost of the owner by men sent out by the Council. Refusal to admit the men sent by the Council is punishable by fines of from £5 to £50. This first law came too late in the season to allow of sufficient preparations to be made for inspection. There are about 193,250 herds in the country; of these 124,893 were freed from the maggots in 1923. As a result the percentage of hides damaged by the maggots was somewhat reduced.

A new law was enacted on December 21, 1923, by which it was required that all keepers of cattle should rid their beasts of maggots of the warble fly during the years 1924 and 1925. The law is very similar to the first law. It lays down certain rules as to compensation to be paid if an animal should die as an immediate result of the treatment to remove or kill the maggots.

In 1924, 178,044 herds were examined; in 29·6 per cent. of these, maggots were found and exterminated. Similarly in 1925. On account of foot-and-mouth disease, inspection was prevented in many districts; the work of extermination was not, therefore, as thorough as it might otherwise have been. Nevertheless, the results were most encouraging. The percentages of hides damaged by maggots were found to be

In 1922	.. ..	20 per cent.
In 1923	.. ..	15 „
In 1924	.. ..	4½ „
In 1925	.. ..	4 „

and the actual loss in value by the damage was estimated to have been reduced between 1922 and 1924 to one-tenth.

Notwithstanding the adverse conditions, due to the prevalence of foot-and-mouth disease, the above results show that the total extermination of the warble fly can be accomplished in the course of a few years. It was therefore decided to proceed on the same lines, and on February 9 this year a law was passed very similar to the law of 1923, this new law to remain in force until the end of the year 1930, by which time it is hoped that the warble fly pest will be extinguished so far as Denmark is concerned.

POISONOUS PLANTS ON THE FARM*—II

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POPPY FAMILY (*Papaveraceæ*)

THE common poppies (*Papaver* sp.) are not only very troublesome light-land weeds, but are actively narcotic and poisonous. The common red poppy (*P. Rhœas* L.) is stated by Cornevin to be poisonous in all its parts, and to be the cause of accidents every year. Poisoning of domestic animals may occur if they are fed with fodder crops which are infested with poppies, and also when they ingest the capsules and seeds with other waste matter from the winnowing or grading of cereals. Cattle have been occasionally injured by eating unripe poppy-heads when the plant was mixed with clover and sainfoin (Henslow). A case is known, however, in which cattle were not injured when fed on vetch hay containing poppies before these had formed seed. In the open farm

* The first article appeared in the December, 1926, issue of this JOURNAL, p. 801.

animals are usually safe where poppies abound, as the unpleasant odour and taste of the plants render them obnoxious. It may be added that the drugs morphine, opium, and laudanum are prepared from poppies.

THE PEA FAMILY (*Leguminosæ*)

Indian Peas.—Various species of *Lathyrus* met with in Spain, Italy, Africa, and other parts of the world are poisonous, and have often led to fatal results when consumed in excess by animals. In 1894 no fewer than 123 horses out of 800 belonging to the Bristol Tramways Company became ill through eating so-called Indian peas (the seeds of *Lathyrus sativus*), and many of them died. In a case at Liverpool in 1884 35 out of 74 cart horses were similarly affected, and 19 died, 2 were slaughtered and 14 recovered. They were, however, given 3 lb. to 4 lb. per head per day. In smaller proportion the peas might have had no ill effects. When roasted or boiled they seem to be less harmful, if not innocuous, for in India the seeds of *L. sativus*, there known as mutter peas, are ground into flour and used for bread. Water in which the peas are boiled should be thrown away. Prolonged use of the peas in quantity may give rise to *lathyrism*, which is marked by general paralysis of the legs in man and the hind legs in animals. Males are stated to be specially affected. Horses, cattle, sheep, and pigs may be involved. South European and North African species (*L. clymenum* and *L. cicera*) may produce similar effects.

Yellow Vetchling (*L. Aphaca* L.), a British species, has caused violent headaches and vomiting in the case of persons who have eaten the seeds. This plant occurs in cornfields from the Midland counties southwards, and flowers in June and July. It grows to a height of 1 ft. to 3 ft., and bears large leaflike stipules and long tendrils. The pale yellow flowers are produced singly at the nodes (Fig. 1).

Lupines (*Lupinus* sp.) are sometimes, but not extensively, grown in this country on the farm, but various kinds are well known in garden cultivation, where they are highly valued for ornamental purposes. Some species are valuable forage crops, and useful for reclaiming sandy soils, being usually ploughed in or folded with sheep. Of these the yellow lupine (*L. luteus* L.) and blue lupine (*L. angustifolius* L.) are grown most extensively. The yellow lupine has caused much

trouble on the Continent, especially in Germany. Cornevin states that in 1880 no fewer than 14,138 out of 240,000 sheep fed upon it, or 5·89 per cent., died after suffering from a complaint termed *lupinosis*. Sheep were chiefly affected, because it was to this class of stock that the crop was principally given, but cattle, goats, and horses did not escape. In the United States also some species of lupine have caused very heavy loss, as of 1,900 out of 3,000 sheep in a case in Montana in 1900. In recent American investigations the toxicity of five alkaloids isolated from lupines was ascertained.* Lupinosis has also been reported to be due to a substance related to the bacterial toxins and called lupinotoxine, but there is some doubt as to this.

The quantity of the alkaloids present may vary considerably according to soil, climatic conditions, manuring, and other factors. In one case, for example, lupines were grown for 12 years by a farmer without harmful results when given to sheep; then 120 sheep out of 450 became ill, and 80 died. The seeds are the most toxic, the pods are less toxic, and the leaves the least toxic part of the plant, and drying the plant in conversion to hay does not render it harmless. The conditions of poisoning, however, are extremely indefinite, though it has been held to be proved that the presence of a fungus is a necessary condition of lupine poisoning. The effects may be acute and rapid, or less acute and chronic in character. The symptoms of poisoning from the five alkaloids were observed in the American investigations mentioned above. All cases showed depression and muscular paralysis, and death (if occurring) follows from asphyxia; sparteine poisoning is distinguished from poisoning by the other alkaloids by the occurrence of general spasms. The earliest symptoms with the four alkaloids other than sparteine are restlessness and mild excitement succeeded by depression; fatally poisoned animals soon become paralysed, the hind legs being affected first; the eyeballs protrude, dyspnœa becomes pronounced, respiration becomes gasping and gradually slows and stops. In sparteine poisoning severe tremors follow the rapid respiration, and paralysis sets in later.

It must be added that lupines are extensively grown on the Continent as a fodder crop, and are generally harmless, and in any case considerable quantities must be eaten to cause

* Stated to be lupanine, lupinine, sparteine, spathulatine, and hydroxylupanine.

fatal results. So serious has the trouble been at times, however, that many investigations have been devoted to the question of a means of rendering them harmless. At least four methods are practised on a considerable scale in Germany, where the plant is grown extensively for reclamation purposes. Briefly two of these methods are as follows: The Kellner method consists in soaking for 24 hours in cold water, then steaming for 1½ hour, and finally washing out with cold water for 45 hours. The Thoms method consists in soaking for 12 hours in cold water, then steaming for 1½ hour, then treating with 0·5 per cent. hydrochloric acid for 12 hours, then washing out with cold water for 45 hours. Recent scientific investigations have established that these methods are quite effective, while two other methods were not found to be effective.

As regards the effect of these treatments on the nutritive value of the lupines, all were found to lead to a loss of digestible nutrients—principally in the carbohydrates and minerals; the true proteins were, however, found to be little affected—an important point, since lupines are chiefly used to supply the protein constituent of the ration. Lupines so treated were found to contain 36 per cent. of digestible protein and to have a starch equivalent of 78. Lupines treated by the Kellner and Thoms methods were used for all classes of stock.

In this country lupines seem to be most commonly grown by farmers in Suffolk, and the blue variety is most in favour in that county.

Java Beans (*Phaseolus lunatus*) are the seeds of a foreign bean which have been occasionally imported into this country from the East for feeding purposes, and, owing no doubt to their general similarity to white haricots and butter beans, have found favour with farmers and others. In the first few years of this century there occurred a number of cases of poisoning by so-called "Java" beans. In March, 1906, the Board of Agriculture published a report of the poisoning of farm animals at eight centres. In relation to two of them the number of animals was not stated, but at the other six 133 head of cattle were involved, and of these no fewer than 43 died. The meal on which the animals were fed was prepared from the beans of *P. lunatus*, of which several types occur in cultivation and in the wild state. The different types are of different origin and are variously described as Rangoon beans, Lima beans, Java beans, Burma beans, and Paigya beans. They exhibit considerable differences in colour, some of them

being creamy-white, and others reddish-brown, brownish, or pinkish with purplish spots and blotches, purplish-black, or black with white stripes.

The poisonous principle is phaseolunatin, which, under certain conditions, gives rise to prussic acid. The largest proportion of the poison appears to be contained in the coloured beans ; the white or cream-coloured forms (usually Lima beans or " white Rangoon beans ") contain much less, or none at all, and are in general safe for feeding to stock. The coloured forms are liable to prove poisonous. Before any doubtful kinds of beans are used for feeding purposes their identity should be ascertained, and they should be purchased under guarantee.

Laburnum (*Cytisus Laburnum* L.) is a decorative tree, well known throughout the country, the drooping racemes of yellow flowers appearing in May and June. As it may often overhang a park or other pasture in which stock are grazing, it must be mentioned, as it is one of our most poisonous plants. It is stated by Henslow to be " certainly one of the most poisonous of all trees cultivated in gardens " ; and Cornevin remarks that numerous experimental researches have proved that the wood, bark, leaves, flowers, seeds, and roots are poisonous, the seeds especially so. He found that 1 lb. of the seeds would kill a horse weighing 10 cwt. The poisonous principle is cytisine. It is stated that there is marked seasonal variation in the amount of poison present in the leaves and pods owing to migration of the poison into the seeds. A case was recorded by the Board of Agriculture in 1908, in which two horses were alleged to have been poisoned in North Wales by eating laburnum seeds, which were found in their stomachs on *post-mortem* examination, although in very small quantity. Ruminants are much less susceptible than horses, in fatal cases of which death is stated to take place in great agony. Many children have been poisoned, and fatally so, through eating the flowers and seeds.

BRYONY (*Cucurbitaceæ*)

Bryony (*Bryonia dioica* L.) is one of the best-known hedge climbers of the countryside in England, but is not found in Scotland and Ireland (Hooker). The leaves are five-lobed, light green in colour, and the plant climbs by means of long threadlike tendrils, which twine round other plants for support (Fig. 2). The rootstock consists of large fleshy tubers, " sometimes nearly two feet long, thick as a man's arm, white,

succulent, and fleshy, with an acrid, bitter, and disagreeable taste" (Henslow). The flowers are quite small and greenish-white, appearing between May and October; they give rise to red berries. Bryony has an unpleasant odour, and contains a milky, nauseous juice. It is a highly irritant plant, and the tuberous roots have been the cause of the poisoning of whole families who have eaten them instead of parsnips and turnips. It has been estimated that 40 berries would cause the death of a man, and that 15 would similarly suffice in the case of children (Cornevin). Though in the case of man it has been the cause of considerable trouble, no deaths of domestic animals have been noted. Yet animals might conceivably eat it in time of scarcity, poultry eat the berries, or grazing pigs might root out and eat the large fleshy rootstocks. The poisonous principle is bryonin.

THE HEMLOCK FAMILY (*Umbelliferæ*)

A number of wild plants of this group are very highly poisonous and have caused very many losses of farm live stock and deaths among human beings. They are related to the carrot and parsley and have a somewhat similar general appearance to one another, but differ in detail. The most important of them are hemlock, water dropwort, cowbane or water hemlock, and fool's parsley. Opinions differ considerably, however, as to which is the most deadly, as the account below will show.

Hemlock (*Conium maculatum* L.) may attain to five feet or more in height. It has a hollow, smooth stem, somewhat shiny, and more or less thickly dotted with purplish spots (Fig. 3). The leaves are large and compound, and the segments are deeply cut, as in most plants of the order. Hemlock is commonly found in waste places, on banks, near hedges, and by roadsides and streams, and in Yorkshire is found at an altitude of 1,000 ft. It is a strikingly handsome biennial, and flowers in June to July, the small flowers being white and in "umbels." Owing perhaps to the fact that the whole plant, especially when bruised, emits an unpleasant mousy odour, it appears rarely to be touched by stock when in the growing state, although in the United States, where it has become naturalized, many domestic animals have been killed by it. Cattle, horses, sheep, and pigs have all been poisoned by hemlock. Goats and sheep are believed to be much less affected than other stock. The early spring is the time when it is

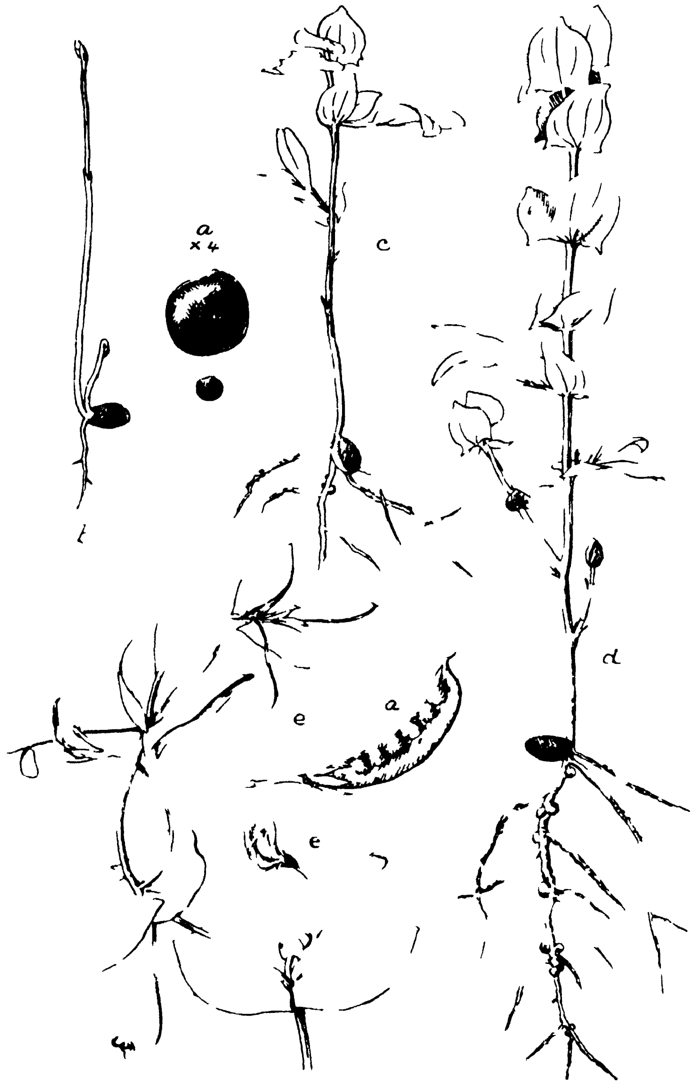

FIG. 1 Yellow Vetchling (*Lathyrus Aphaca* L.)

a Seed natural size, and × 4, *a'* Pod, *b* Seedling early stage, *c* Seedling second stage, *d* Seedling third stage, *e* Portion of Flowering Stem, *e'*. Flower (*a'* to *e'* natural size.)

POISONOUS PLANTS ON THE FARM, II

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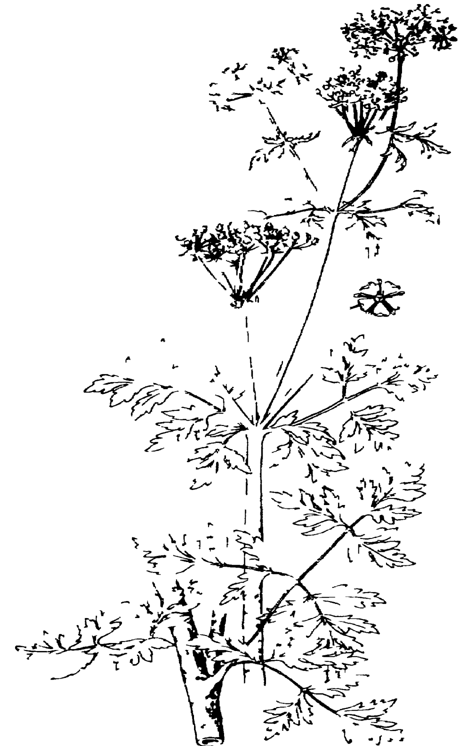
Fig. 2—Bryony (*Bryonia dioica* L.)



G. 3 —Hemlock (*Conium maculatum* L
$\frac{2}{3}$, with flower enlarged.

Fig. 4 Water Dropwort (*Oenanthe Crocata* L.)

1 Root reduced, 2 Leaf, × [illegible], 3 Flower head [illegible], 4 Flower [illegible] about [illegible], 5 Fruit, [illegible], 6 Single fruit [illegible] about [illegible]

FIG. 5. Fool's Parsley (*Aethusa Cynapium* L.)

a. Fruit, natural size and magnified; *b*. Seedling, first stage; *c*. Seedling, second stage; *d*. Seedling, third stage; *e*. Portion of Flowering Stem, reduced, with flower below enlarged. (*b*, *c* and *d*, natural size.)

likely to be most dangerous, fresh green herbage being then most scarce. The German authority, Pott, states that after eating hemlock cows produce milk having an unpleasant flavour. Cases of human poisoning have arisen from eating the seeds for those of anise, and through using the leaves for parsley; the roots have also been mistaken for parsnips and eaten with bad results. The plant has been known from ancient times to be poisonous, and it was probably the poison of the hemlock which was administered to the philosopher Socrates by the Greeks.

The poisonous principle consists of several alkaloids, the chief of which is coniine, which is volatile. The poison is at first chiefly seated in the leaves, but later in the fruits or "seeds," which Cornevin states are more toxic before than after maturity. As in the case of certain other plants, the poison is largely dissipated when the plant is dried, as in hay. The root is less poisonous than the rest of the plant, and is said (*U.S. Farmers' Bull.*, No. 86) to be nearly harmless in March, April, and May, but dangerous afterwards, especially during the first year of its growth. Writing in 1909, Ewart noted that hemlock had recently been responsible in Victoria for the poisoning of a number of cows and for the death of a child; it became a "proclaimed plant" for the State in 1907. The plant should be avoided as food in any form by man or animals, and where there is danger of its being taken in this way it should be eradicated by hand pulling as fast as it appears, or by repeated cutting.

Cowbane or Water Hemlock (*Cicuta virosa* L.) is a weed which grows in damp, watery places, as by the edges of ponds, ditches, rivers, etc., from the southern counties as far north as Dumbarton and Forfar, and in Mid- and North Ireland, but is local and seldom abundant. It is a perennial plant of 2 ft. to 4 ft. in height, with large compound leaves, the serrated segments of which are long and narrow; the small white flowers are produced in July to August, and occur in umbels 3 in. to 5 in. in diameter. The stem is stout, furrowed, hollow, and somewhat branched, and the rootstock short, fleshy, and hollow. It has been mistaken by man for celery or parsnip with fatal results. Animals are not usually attracted by this plant, but it is highly poisonous and has often proved fatal to farm stock, sheep and goats being the least readily affected and cattle the most susceptible. Small quantities are sufficient to cause poisoning. Like water dropwort (*see* below), it proves

dangerous to cattle at grass when herbage is scarce, and when the plant has been dug out of ditches, etc., and left lying on the banks. It is poisonous in both the fresh and dried state. Cornevin says that cowbane is regarded as being the most harmful of the umbellifers. The fleshy rootstock is the most harmful part of the plant. Mueller indicates that 1 lb. of the dried plant would suffice to kill a horse. When removed in clearing out ditches this plant should be burnt, and when found where stock have access to it it should be destroyed.

Water Dropwort (*Œnanthe crocata* L.), also, like cowbane, sometimes termed water hemlock, is a poisonous plant which is much more frequently the cause of harm to live stock than cowbane (*see* above). It is a perennial weed of 2 ft. to 5 ft. in height, which occurs in damp meadows, marshes, ditches, and other wet places from Argyll and Elgin southwards. The leaves are large and compound, with much divided leaflets (Fig. 4) The small flowers are white, in large umbels on terminal stalks, and appear about July. The stem is grooved, hollow, and branched, while the rootstock is a fleshy and spindle-shaped "tuber." All parts are poisonous, especially the fleshy rootstock. The leaves have been mistaken for celery, and the roots for parsnips, with fatal results. Johnson and Sowerby (1861) record the poisoning of 17 convicts working near Woolwich who came across water dropwort and ate it in mistake for celery and parsnips. Nine suffered from convulsions; four of them died within a few hours and two more during the next few days. It is not rendered harmless by drying. When ditches are cleaned this plant may be thrown out on the banks, and cattle are not infrequently poisoned by eating these clearings. The poisoning of horses, cattle, and sheep has been recorded in the veterinary and agricultural Press, and there can be little doubt that the plant causes loss of stock every year. In the *Pharmaceutical Journal* for 1902 this plant was mentioned by Holmes as the most dangerous and virulently poisonous of all our native species. Its effects are very rapid, and fatal results may follow within a few hours after ingestion of the plant. Both stem and root contain juice which becomes yellow on exposure to the air. The root is the chief seat of the poisonous principle, and hence the most dangerous part of the plant. It is clear from the literature on the subject that a very little of the root is sufficient to cause death, and Cornevin quotes the following amounts of the fresh root as sufficient to cause poisoning of live stock :—

Horses	.. ..	1·00 lb. per	1,000 lb. live weight.
Cattle	.. ..	1·25 lb. „	1,000 lb. „ „
Sheep	.. ..	0·21 lb. „	100 lb. „ „
Pigs	.. ..	0·15 lb. „	100 lb. „ „

Other poisonous species of *Œnanthe* are met with in Great Britain in damp situations.

Fool's Parsley (*Æthusa Cynapium* L.) is a small annual weed of gardens and cultivated fields, attaining to a height of 2 ft. (Fig. 5). It occurs from Elgin southward, and also in Ireland. The stem is hollow, striated, and branched. The foliage is compound, and resembles parsley, but is very dark green in colour. The flowers are small, white, and irregular, bear long drooping bracts, and open between July and September. (The flowers of true parsley are yellow.) The roots are spindle-shaped, slightly resembling radishes. The plant emits a nauseous odour when bruised. Some authorities regard it as more or less harmless, but others hold it to be strongly poisonous, and there can be no doubt that in some circumstances it certainly is so. Cornevin says that at the time he wrote it was regarded as the least active of all the hemlocks, though it has been the cause of more accidents to man. The foliage and root have been the cause of the death of human beings owing to their resemblance respectively to parsley and radishes. Owing to its unpleasant odour farm stock are probably only likely to take it in times of scarcity of other green herbage. An investigation of the plant by Messrs. Power and Tutin some years ago showed that it contained a principle similar to the coniine of the hemlock, though in very small amount. Climate and the stage of development, however, might involve the presence of larger quantities, and the authors were led to observe that "it cannot be considered improbable that under favourable conditions of growth the proportion of alkaloid may be increased to such an extent as to impart to the plant the poisonous properties ascribed to it." A correspondent informed me some years ago that in North Lincolnshire this weed is sometimes very annoying on the low, clayey, peaty alluvium, and is difficult to eradicate, even a bare fallow in one year failing to reduce it effectively, the next year's wheat crop being full of it. The weed, however, is an annual, and two successive root crops regularly and thoroughly hoed should considerably reduce it.

PYRETHRUM-GROWING FOR INSECTICIDAL PURPOSES

(*A Preliminary Report*)

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Plant Pathological Laboratory, Harpenden.

IT has been known from the earliest times that various plants of the chrysanthemum family have insecticidal properties, and this knowledge is often reflected in such names as "fleabane," which are still current, though the plants' powers, or supposed powers, of repelling insects are no longer employed. One plant of this family, however, known as "pyrethrum" or "buhach," is still of considerable importance as producing one of the principal ingredients of domestic insect powders, and recently, owing chiefly to French and Swiss investigations, it has found an increasing use in vine-growing and horticulture.

Properties of Pyrethrum Insecticide.—Pyrethrum insecticides are very toxic to most insects, which they kill or paralyse by contact (as opposed to poisons taken internally), and they have the additional and very great advantage of being harmless to man and domestic animals. On the other hand, they are very quick to lose their toxic properties when exposed to the air, and in the crude condition have been found to vary so greatly in strength that the production of an article sufficiently standardized for general horticultural use has been exceedingly difficult, if not impossible. However, the value of pyrethrum for certain purposes, and specially its harmlessness to everything except insects, has again attracted attention, and the more recent Swiss and French work indicates that its disadvantages may be mitigated, if not overcome, by improved methods of cultivating the plant, and subsequently of extracting its active principles.

Sources of Pyrethrum.—The pyrethrum of commerce consists of the dried flowers or flower-buds, subsequently ground to powder, of three species of chrysanthemum (using the term in its botanical sense), of which two (*C. carneum* Bieb. and *C. roseum* Bieb.) are found wild in Asia Minor, the Caucasus and Persia, and the third (*C. cinerariæfolium* Trev.) in Dalmatia, Montenegro, Herzegovina, and the neighbouring countries. It is said that present supplies are derived almost wholly from the Dalmatian species and come partly from Dalmatia itself and partly from Japan, to which country the crop was introduced some forty

years ago, and where it is now extensively cultivated. The unsatisfactory nature of these supplies has recently persuaded the Swiss and French to attempt again the growing of the plant in Western Europe—an experiment which had several times been made, but never on a sufficient scale to test the commercial possibilities of the crop. These further trials were more comprehensive than those made previously and met with considerable success, with the result that pyrethrum is now being produced on a commercial scale in France and Switzerland as well as in North Africa. The fact that pyrethrum could be successfully grown as far north as Paris suggested that the crop should at all events be tested in England, and, thanks to the generosity of M. Vayssière, of the Entomological Station of Paris, a supply of seed of Swiss origin was received in the late summer of 1924. By a fortunate coincidence, Messrs. A. Joensson & Co., of Kobe, who had also suggested the growing of pyrethrum in England, were able early in 1925 to present to the Ministry considerable supplies of Japanese seed, for which assistance the warmest acknowledgments are now made.

Pyrethrum-Growing in England.—Accounts of pyrethrum-growing in France and elsewhere suggest that the plant is rather particular, preferring a warm situation, and a soil which is dry, well supplied with lime, but otherwise poor. As the exact importance of these conditions was unknown, it was decided to test the crop at a number of stations throughout the southern half of the country, and, through the kind co-operation of the authorities concerned, plots are now in existence at the following places:—Royal Botanic Gardens, Kew; Royal Horticultural Society, Wisley; South-Eastern Agricultural College, Wye, Kent; East Malling Research Station; Swanley Horticultural College; East Sussex County Agricultural Committee, Lewes; University College, Reading; Southampton County Agricultural Education Committee, Sparsholt; Long Ashton Research Station, Bristol; Seale Hayne College, Newton Abbot; Isle of Scilly Experiment Station; University College, Aberystwyth; Isle of Ely Education Committee, Wisbech; Middlesex Education Committee, Denham, Bucks. In addition there are plots at the Plant Pathological Laboratory, Harpenden.

Owing to the fact that the Swiss seed arrived earlier than the Japanese, and also because of initial failures in the seed-bed and the consequent necessity for resowing, there is con-

siderable variation as regards the age of the plants between one plot and another. As a result, any discussion as to the relative suitability of the various localities for growing pyrethrum would be premature. Some observations common to a majority of the plots may, however, be made.

Sowing the Seed.—Seed-sowing has been tested both in the open and under glass, and as a whole sowings made in the open failed. Under glass the Swiss seed germinated well, but the Japanese only to about 33 per cent. Sowing was carried out both in late summer and spring with good results, but perhaps the former has proved better, since the seedlings, when pricked out in cold frames, withstand the winter without trouble, and, being planted out the following spring, have the whole summer to become strong plants for flowering the subsequent year. (Fig. 1.) Plants from seed sown in the spring grow equally well, but are not so large by autumn, and are therefore less likely to crop the following year. (Fig. 2.)

Hardiness.—As regards hardiness, it was perhaps fortunate that the winter of 1925-26 was exceptionally trying, severe frosts being experienced in addition to the damp cold usual to the climate. In spite of this, the plants—both of the Japanese and Swiss strains—showed no ill-effects whatever, and this was the same whether the soil was the water-logged clay of Harpenden or the sands of Surrey. On the whole, the first experiences suggest that, although cold-frame treatment is desirable, or even necessary, in the seedling stages, the plant is perfectly hardy and takes kindly to most soils, and is, in fact, as easy—if not more easy—to grow than the common garden pyrethrums.

Harvesting.—The next consideration is the harvest. Appreciable crops were produced at East Malling, Newton Abbot, Wye, Isles of Scilly, Wisley, Sparsholt, and Harpenden, and smaller amounts from a few of the more precocious of the younger plants at Denham and Reading,* but owing to differences in maturity of the plants, a fact to which attention has already been drawn, any reference to the relative yields might prove misleading—except, perhaps, in the case of Harpenden plants from Swiss seed, which, owing to the advantage of an early start, were fully mature and were harvested during June, three pickings being taken just before the flowers were fully open. The flowers were cut with a

* Fine plants were grown at Kew, but were used for making replacements in other plots which did not contain their full complement.

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Fig. 1. Pyrethrum at Harpenden. Swiss seed, sown Sept. 25, 1924, under glass; planted out April 7, 1925; photographed at harvest, June 19, 1926. Plants 18 in. by 18 in. apart.

FIG. 2. Pyrethrum at Harpenden. Swiss seed, sown May 9, 1925, under glass; planted out July 24, 1925; photographed June 19, 1926. Plants 18 in. by 18 in. apart.

convenient length—about 16 inches—of stalk, since it was found in France that the stalks contain appreciable quantities of the insecticidal substance. Altogether 21 lb. of fresh flowers, neglecting stalks, were gathered from an area of 1 rod, and when dry weighed 5 lb. This compares quite favourably with a French estimate of 2½ lb. per rod as the crop reasonably expected in France, although from specially selected strains in Morocco ten times this yield has been obtained. Drying was carried out by exposing the flowers in trays and on sheets to the sun for three or four days until the stalks were crisp. Then they were kept for a further period of three or four weeks in a dry shed which, on suitable days, could be freely ventilated, and when quite dry they were stored in closed metal containers.

Finally, it may be mentioned that the plants which cropped in 1926 are still growing strongly and give promise of persisting for at least another year. In France it appears that a plantation is expected to last for some eight to ten years.

Quality of the Crop.—Judging by Continental writers on pyrethrum, it was considered not unlikely that, while the plant might grow in England, the flowers would be deficient in active principle, except perhaps in hot seasons and in specially favoured localities. The 1926 crop was not harvested in time for any extensive trials to be made, but it is interesting to find from preliminary experiments that English-grown flowers, both of the Swiss and Japanese strains, are decidedly toxic to insects. Alcoholic extracts corresponding to ¼, ½, and 1 lb. of dried flowers per 10 gallons of water have all proved destructive to the caterpillars of the thorn moth (*Selenia tetralunaria* Staud Cat.) and of the large cabbage-white butterfly, although in the laboratory consistent results have not yet been obtained. Mr. Theobald, of Wye, who used aqueous solutions in the open, obtained good controls of the small cabbage-white caterpillar and of the diamond-black moth caterpillar, but, as at Harpenden, found unaccountable difficulties in getting equally good results against the large cabbage-white butterfly caterpillars. However, tests so far have only been of a quite preliminary nature, and nothing in the way of conclusions are justified.

Results.—The first results of the experiment are, nevertheless, unexpectedly hopeful, for it is clear that cultivation in the English climate should present few difficulties, while at all events in 1926—not too favourable a summer—the product

is at least of fair average quality when compared with French commercial samples. Full tests must next be made with the pyrethrum from the different stations, and in this the valuable co-operation of the chemical department of Rothamsted has been secured. If these tests prove favourable, the commercial aspects of pyrethrum-growing will need more careful examination: on the evidence at present available it is at least clear that pyrethrum-growing for insecticidal purposes is worth further exploration.

Thanks are due to the Directors and Staffs of the Colleges, Research and Experiment Stations previously mentioned for their generous help in providing ground for the experiments, and for the care and attention the work received.

CLEAN MILK EXHIBITS AT AGRICULTURAL SHOWS

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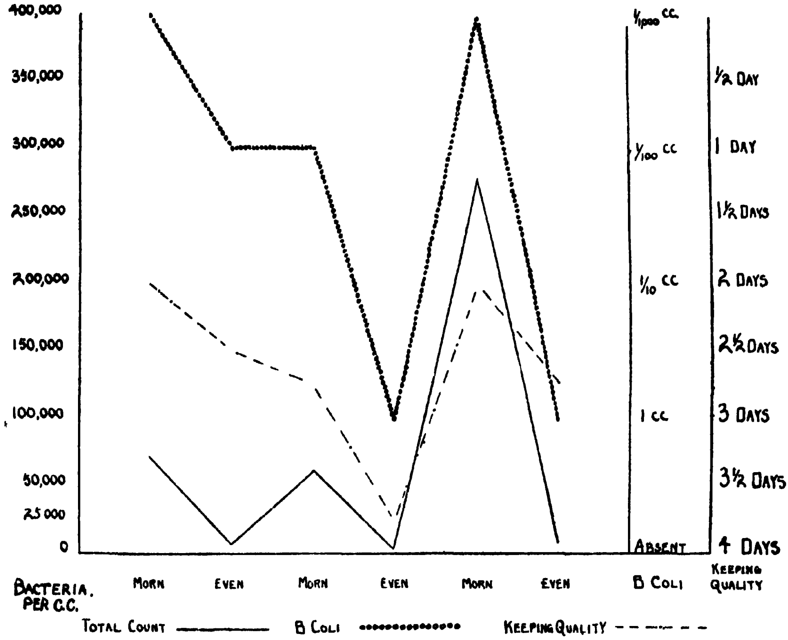
AGRICULTURAL shows offer good opportunities for enlisting interest in the question of clean milk and for giving information to those who wish to produce a pure article. The character of clean milk exhibits, however, shows a tendency to become stereotyped; it is important, therefore, that new features should be devised to stimulate the zeal of those already conversant with the subject and to provoke the attention of others.

Space for such exhibits at shows is necessarily restricted, usually limited to a few square feet, and it is often very difficult to decide how to utilize it to the best advantage. If a Clean Milk Competition has been held locally, the problem is simplified, since, by giving judicious prominence to the results, considerable enthusiasm may be stimulated.

Competition Results in Graphic Form.—At the West Midland and other shows last year (1926) the figures provided by the Shropshire Clean Milk Competition were utilized for a graphic display. Very great interest was evinced in some curves drawn out to demonstrate the progress or otherwise of certain competitors. These graphs, so far as is known, were the first attempt to convey at a glance information regarding total count, *B. Coli*, and keeping quality. The co-ordinates were plotted in such a way that the total bacterial count, *B. Coli*, and keeping quality at 60° F. formed the three ordinates of the


400,000
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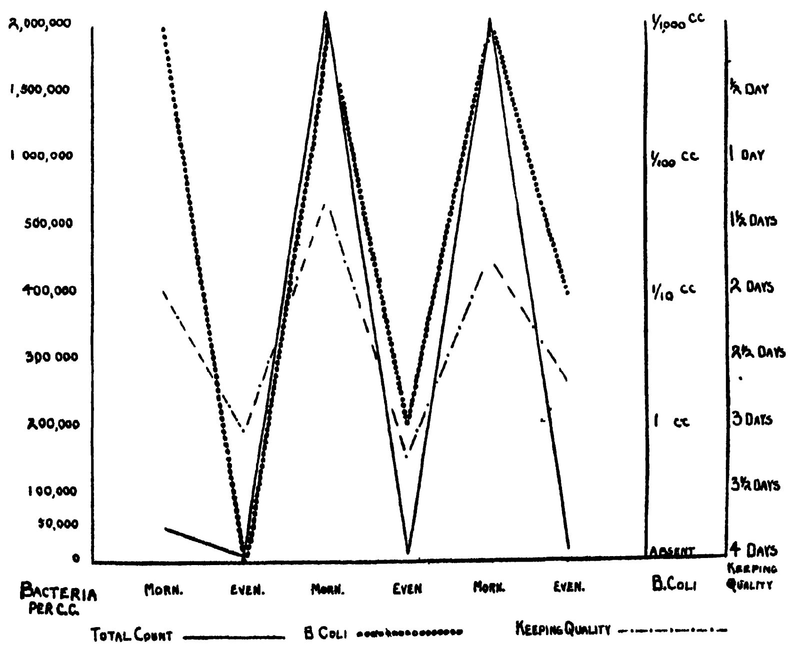
ABSENT
1/2 DAY
1 DAY
1 1/2 DAYS
2 DAYS
2 1/2 DAYS
3 DAYS
3 1/2 DAYS
4 DAYS
BACTERIA. PER C.C.
MORN
EVEN
MORN
EVEN
MORN
EVEN
B COLI
KEEPING QUALITY
TOTAL COUNT
B COLI
KEEPING QUALITY

FIG. 1.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1 CC
ABSENT
1/2 DAY
1 DAY
1 1/2 DAYS
2 DAYS
2 1/2 DAYS
3 DAYS
3 1/2 DAYS
4 DAYS
BACTERIA PER C.C.
MORN.
EVEN.
MORN.
EVEN
MORN.
EVEN.
B.COLI
KEEPING QUALITY
TOTAL COUNT
B COLI
KEEPING QUALITY

FIG. 2.

graph, whilst the abscissa was divided into six parts, representing the six rounds of the competition. It will be seen that the total number of bacteria and the number of coliform organisms increase in passing from the bottom to the top of the graph ; the keeping quality, on the other hand, decreases in a similar direction. In other words, high bacterial contamination is plotted alongside a low-keeping quality, and vice versa.

The obvious reason for such an arrangement was to demonstrate the relationship, if any, between bacterial contamination and the keeping quality of milk, as, if any such relationship existed, a similar type of curve would be found in each of the three cases. By reason of the different nature of the three sets of data under consideration, it is impossible to obtain strictly comparable scales of measurement, so that complete coincidence of the three curves was not expected, nor indeed necessary.

In point of fact, the correlation obtained was remarkably close, as will be seen from the figures. It is considered that curves of this nature make the results more readily intelligible than a mass of figures, since the progress of a competitor is immediately visible. Examinations of a number of curves showed quite conclusively that the keeping quality depends equally upon the total bacterial content and the degree of contamination by *Bacillus Coli.* Any regular disparity between morning and evening samples of milk also stands out very clearly, as will be seen from figure 2. In the case of this particular competitor the high bacterial count in the morning samples was discovered to be due to the mixing of left-over evening milk with the morning milk.

Curves on the lines of those in figures 1 and 2 prominently displayed in an exhibit never fail to produce a large crop of questions and provoke much useful discussion. They are of special interest to the workmen engaged on farms competing in clean milk competitions, to whom mere statements of figures make no appeal at all.

Other Forms of Exhibit.—The cotton-wool straining discs used for sediment tests in the Shropshire Competition were mounted and framed as an exhibit. Although there is little correlation between visible dirt and bacterial contamination, the discs make a quite useful demonstration, and one that appeals to the least intelligent. Another exhibit which has been most valuable and provocative of interest is a small scale model of an ordinary farm copper or boiler, adapted for use as

a simple steam sterilizer on the lines recommended by the National Institute for Research in Dairying. About six inches high, made of three-ply wood, painted to look like brickwork, the model has a perforated lid and steaming box complete. When set up with a model churn over the jet it seems to attract immediate attention and inquiry.

It has been found that plates showing bacterial colonies do not excite much attention from the average person, possibly because the light in a tent is not very good and the colonies are not clearly seen, but more probably because, if seen, they are not easily understood. The number of such plates which can be usefully employed is small, and it would be better to dispense with these and statistical statements in favour of exhibits which, if less purely scientific, are more generally attractive.

THE GRADING OF EGGS*

Should Eggs be Graded ?—Practically all the 2,500 million eggs annually imported into this country are more or less closely graded by weight before they leave the country of origin. The purpose of grading by weight is to bring about uniformity in size. This is preferred by distributors and appeals to consumers. In some countries efficient grading is a statutory requirement ; the Governments of Northern Ireland, the Irish Free State, Canada, South Africa, Denmark, Norway, Latvia, and Esthonia are among those that have taken legislative steps in this direction. Eggs from these countries find their way to distributors up and down England and Wales, who are quick to appreciate the fact that methodical grading enables them to order their precise requirements in terms of eggs weighing, say, 15 lb., 16 lb., 17 lb., or 18 lb. per 120, and to be reasonably sure of getting what they want. But grading according to weight is not sufficient ; condition must also be considered. Many exporting countries have, therefore, prescribed standards of internal quality in order to ensure that the eggs they send to the British market attain a high degree of excellence and can be relied on by distributors here. Finally, there is the growing demand that imported eggs should be made identifiable.

On the above facts rests the *prima facie* case for the systematic testing and grading of eggs from the surplus-producing areas of this country that are sent to the large

* The Ministry's *Marketing Leaflet No.* 1, copies of which may be obtained free and post free on application.

consuming centres for sale in competition with tested, graded and, in some instances, guaranteed produce from surplus-producing areas abroad. The sale of a product is based on human valuations: the distributor, whether wholesaler or retailer, has a choice; eggs from all over the world compete for his patronage and he may be expected to buy those which, in his experience, he can sell to best advantage.

The English new-laid egg is unsurpassed in quality, but it is unnecessarily handicapped in the trade by failure to grade and by the lack of standard grades that are recognized and applied uniformly throughout the country. *Graded eggs can be sold to distributors on the basis of grade without personal inspection; this facilitates sale direct from producing areas, reduces marketing costs, facilitates forward contracts with distributors and minimizes disputes. Grading reduces transportation costs by keeping unmarketable eggs at home, increases market value, encourages a high standard of production, and is the essential foundation of advertisement. A standard grading system makes possible the effective quotation of market prices; it begets confidence, promotes business, and widens the market all round.*

Clearly, the question "*Should eggs be graded?*" admits only of an affirmative answer, particularly in regard to eggs from areas, such as the Eastern Counties, Somerset, Devon, Cornwall, Cumberland, Westmorland and parts of Wales, that are surplus to local requirements and have to find a market farther afield. What producers must consider is *how, where* and *by whom* shall grading be carried out.

How?—The Ministry of Agriculture has recently conducted an investigation into the methods of marketing eggs; a Report*, based on the investigation, has been issued. In this Report the importance of standard grading is recognized as a first step in the improvement of marketing organization, and a system is outlined for consideration. This is set out below.

Where?—In order to derive the maximum advantage from grading, it should, as a general rule, be carried out in the producing areas before the eggs are consigned away.

By whom?—The answer to this depends on circumstances. Large-scale producers may find it both practicable and convenient to grade their own supplies whether for sale direct to

* *Report on Egg Marketing in England and Wales.* Ministry of Agriculture and Fisheries: Economic Series, No. 10; obtainable from His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6d. net; post free 9½d., or from any bookseller.

distributors or through the medium of local markets. Some already do this, but the great majority do not. In any event, small-scale production is the general rule, and it is obvious that small lots of eggs cannot be effectively graded unless they are concentrated at convenient points for the purpose. This concentration is effected every day in the surplus-producing areas by country wholesalers of the dealer type, who draw their supplies from many farmers and from many markets. Where they exist, collecting depots, organized by producers on co-operative lines, are also assembling centres. Both are in a position to and should test and grade the supplies they handle before dispatching them to buyers.

The Suggested Grading Scheme.—This provides first for distinguishing between eggs of "new-laid" quality and other eggs, and secondly for grading both classes according to weight.

Quality specification	Grade		Weight specification: Weight per 120 eggs, Nominal	Weight specification: Weight per 120 eggs, Actual	Weight specification: Minimum egg weight	Retail selling rate
			Lb	Lb	Oz	Eggs per lb
Eggs that have not been cold-stored or preserved in any way that show the following characteristics :— *Shell* Clean and sound *White* Translucent and firm *Yolk* Translucent or faintly but not clearly visible *Air Space* Not exceeding ¼ inch in depth	English New-Laid	Specials	17	16½ to 17	2⅛	7
		Standards	15½	15 to 15½	1⅞	8
All other eggs fit for human consumption	English Trade	Smalls	14	13½ to 14	1⅝	9

Explanation.—*Quality Grades.*—Having regard to the nearness of home producers to their markets and to the facilities for rapid transport that are, in general, available,

it is reasonable to suppose that, with good faith and good organization on the part of both producers and distributors, the great bulk of home-produced eggs could reach the consumer in new-laid condition. It follows that all that is necessary is to define the term "new-laid"; eggs that fail to attain the "new-laid" standard, but are fit for human consumption, would still be marketable, but not in the "new-laid" category. Similarly, pickled, processed and cold-stored eggs would be sold under their appropriate designations.

The proposed definition of "new-laid" is based on the condition of the eggs as disclosed by the process known as "candling," and is such as to allow for natural condition at all seasons of the year and for the time reasonably necessary to get the eggs to the consumer. It is considered that an air space of ¼ in. is compatible with new-laid condition, when taken in conjunction with the qualification for yolk and white; alone, it is an unreliable guide. Hitherto there has been a tendency to exaggerate the importance of the air space, probably because it is easily measurable; it is variable even in a newly laid egg.

"Candling" is essential for eggs that are to be sold as "new-laid." Age, of itself, is no criterion. It is only by "candling" that abnormalities due to natural causes, or loss of condition due to faulty handling, can be detected.

Weight Grades.—Only three weight grades are suggested; this should facilitate grading by ordinary selection, which is the method intended. The grading should, however, be checked by taking the weights of graded consignments before dispatch.

The majority of home-produced eggs approximate closely to a weight of 2 oz. each. This weight has been the aim of poultry breeders for the past 25 years. A "*Standard*" weight grade of 15½ lb. per 120 eggs serves, therefore, to cover the bulk of home produce. But many poultry breeders are now aiming at a steady improvement in egg size and this must be met by an increase in the value of large eggs if efforts in this direction are to continue. Fortunately, there is a demand for extra-large eggs. The "*Special*" grade of 17 lb. per 120 eggs would best meet this demand and would cover a considerable proportion of the supplies marketed in the spring season. A surplus of small eggs is, however, unavoidable at all times. They have their value, especially in the autumn when their production is at its highest and new-laid eggs of other grades are scarce. To provide for them, a weight grade of 14 lb. per 120 eggs is suggested for "*Smalls*"; this grade would meet

the requirements of hotels and restaurants for "poaching" eggs.

The three weight grades tentatively proposed lend themselves to the retail sale of eggs by weight. Thus "Specials" could be sold at 7, "Standards" at 8, and "Smalls" at 9 eggs to the lb.

Minimum Egg Weight.—In order to ensure reasonable uniformity in size, minimum egg weights have been suggested; the object of grading might otherwise be defeated.

Weight Allowance.—It is recognized that in the autumn there is a natural fall in egg weight due to early pullet production. To allow for this, to facilitate grading by producers who may only handle comparatively small supplies and to allow for grading errors on the part of inexpert operators, a tolerance of ½ lb. per 120 eggs is recommended for each grade. The example of Northern Ireland shows, however, that, as experience is gained, the tolerance can be dispensed with; this is desirable in the interests of the trade.

RECENT PRODUCTIONS OF THE ORDNANCE SURVEY

Summary of a Paper read by Captain J. G. Withycombe, of the Ordnance Survey, before Section E (Geographical) of the British Association Meeting of* 1925.

MAP-MAKING may be regarded from two distinct standpoints—the scientific and the artistic. One of the chief preoccupations of the cartographer should be to reconcile these two aspects; to produce a beautiful map which is also accurate and legible.

In modern times there has been a tendency all over the world to lose sight of the artistic aspect of maps, but, perhaps because the tradition of the old map engravers has to some extent been preserved in the Ordnance Survey, the sheets of the one-inch map still have an æsthetic appeal. The evolution of the Survey small scale maps can be traced direct to the sixteenth century and beyond into the Middle Ages. The first maps produced by the Department were those of the South of England on the scale of one inch to one mile, which were prepared and published under Colonel Mudge in the Tower of London during the first two decades of the nineteenth

* *Ordnance Survey Professional Papers* (New Series), No. 10. H.M. Stationery Office. Price 9d. net.

century. It is easily seen that these maps are a product of a well-established tradition, and it is a fascinating study to trace the development of this tradition through the successive generations of English cartographers to the Ordnance Survey of the present day. It is interesting to note the influence of methods of reproduction on style; the script used in the sixteenth century was engraved but still retained the character of letters written with a reed pen, and was gradually converted into a type of script writing better suited for engraving; the beautiful Roman letters used by the earliest map makers underwent a similar change.

So long as copper plate printing was employed as the only means of reproduction there was very little scope for development, but as engraved maps these early sheets were very complete and any alteration would be likely to spoil them.

Introduction of Lithography.—The introduction of lithography revolutionized everything, making possible the printing of maps in many colours. The engravers' tradition remained, however, and, although large scale plans were lithographed very soon after the introduction of the process, the one-inch map was still engraved and the transfers pulled from the copper plates were laid down on the lithographic stones or zinc plates —a compromise between engraving and the newer process.

Perhaps the strongest reason for the retention of the copper plate as a basis was that it constituted a permanent, stable record upon which alterations could be made, but the process of transferring from copper to stone was not altogether satisfactory. Difficulty was experienced in obtaining a proper "register," much of the fine work was coarsened or failed to appear and accuracy was affected. It was accordingly decided to abandon engraving and to adopt the process of helio zincography, which, while being quicker and cheaper, is very simple and direct.

The Latest Productions of the Survey are the sheets of the new one-inch series of Scotland, and as the smaller scales are all derived from the one-inch these Scottish sheets will largely influence the future small scale maps of this country.

The next edition of England and Wales will be replotted and drawn *de novo*. It is hoped to produce a map, drawn on paper and adapted for reproduction by the helio zincographic process, which, while retaining the traditional style and adapting it where necessary, will make no violent break with the past.

The adoption of the new method has made it possible to introduce some improvements. Each sheet has been made to overlap its neighbours one inch in all directions. The one-inch maps of Scotland, hitherto on Bonnes projection and based on the meridian 4° West of Greenwich, have been transferred to the projection and meridian used for England and Wales, thus avoiding all overlapping and confusion at the border.

Systems of Representation.—In considering details of construction, the features of a map may be divided into two classes —natural and man-made. Among the former the representation of land-forms is of the utmost importance and there is still considerable difference of opinion as to the best system. The method of indicating relief has undergone great changes. The first geographers depicted hills in perspective. These pictured hills gave way to hachures, the hills being shown in plan with shading showing varying degrees of steepness. After the introduction of contours the hachures were still printed in addition, but have now been discarded. The passing of the hachured hills is to be regretted. They did much to enhance the beauty and usefulness of the old engraved maps and have proved effective in combination with contours, shading and layer colouring. Contours have a beauty of their own, however, and indicate land forms more precisely. On the new maps they are drawn at vertical intervals of 50 ft. from sea level instead of at 100 ft. intervals up to 1,000 ft. and thence at 250 ft. intervals as on previous editions. An improvement which brings out the shapes of the hills and facilitates the reading of contours in a remarkable way has been made in the latest maps by thickening the contour lines at each 250 ft. interval.

Water, which prior to the present revision was shown by engraved "water lining," is now outlined in blue and filled with a blue tint, which gives a pleasing effect and clear definition.

Most of the ornamental features of the engraved map such as sand, rocks, woods, etc., have been retained and have been depicted by the draughtsmen even more clearly than by their predecessors the engravers. Several of the draughtsmen employed are ex-engravers.

It is with man-made features that the revisers are principally concerned. The enormous development during the past forty years has rendered the task of mapping the country on a small scale an increasingly difficult one, and the danger of overcrowding is very great.

All houses on the new map are blocked in in solid black. giving the advantages that the shapes can be better defined, the streets stand out more clearly and the towns tell approximately in their relative importance. With the growth of motor traffic the showing and classification of roads has become of the first importance, but possibly the main roads, coloured a strong red, have been over-emphasised.

Road Maps.—A special road revision, made necessary by the great changes to the road system, has just been completed for the South of England. Future reprints of the one-inch, half-inch and quarter-inch sheets will show the new arterial and other roads open for traffic or under construction, and all alteration to classification of the old highways. Several one-inch, half-inch, and quarter-inch sheets with this information have been published.

Archæological information on recent maps has been revised and on the one-inch map has been much improved. In 1924 the new quarter-inch map of Great Britain, produced by drawing in black over prints in blue of the half-inch map, was completed. Although this map may be regarded as the standard motoring map of the country, layer colouring and sea-bed contours convert it into a useful physical map. A large special sheet, "South Central England," has been published. It is convenient for, and much used by, airmen, and serves as a basis for the special air map in preparation.

The first sheet of the new map, designed primarily as a road map, on the scale of ten miles to one inch, has been printed. The whole of Great Britain will be covered by three sheets and an overlap of six inches provided, Sheet III including the whole of Wales and England south of the Humber. The contours, drawn at 200 and 400 ft. and thence at 400 ft. intervals together with layer colours, emphasize the relief without obscuring other details. The coast line with the water, being printed in blue, enables the complete physical map to be separated from the black plate and thus facilitates the use of the series for special maps. The ten-mile map is being drawn on blue prints of the quarter-inch sheets.

Over-Printing.—On new editions of small scale maps as much detail of all classes as possible is shown and, after military necessities have been met, the balance between the civil claims must be kept, giving that prominence to each object which its relative importance merits. The specialist who requires certain data emphasized should use the national maps as a basis and

draw or overprint upon them. The geological maps of the country, produced in this way, are striking examples of the use of over-printing.

The half-inch series prepared and printed by the Survey for the Ministry of Transport is a good example, the roads and road numbers being over-printed boldly in red and green, thus adapting a general topographical map for specialized use.

The Ministry of Health recently carried out a complete survey of the water resources of England and Wales based on the Ordnance Survey maps, the information relating to water supply being strongly emphasized. The data are classified, and each feature is indicated by a symbol and numbered, and the country divided according to catchment areas. The system of references to a card-index makes the whole scheme very complete.

Many Ordnance Survey maps showing archæological distributions have also been published, and there are practically unlimited possibilities for the development of the use of the maps in this way.

To sum up, the aim of the Survey is to give as true and detailed a picture of the country as the scale of each map permits, to improve the cartographic style and legibility of the sheets and to adapt their traditional character to modern methods of reproduction without sacrificing their æsthetic qualities, and, above all, to secure the degree of scientific accuracy which is required at the present day.

THE CONTROL OF WIREWORMS IN GLASSHOUSES

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Introductory.—With the increase of the tomato growing industry in various parts of the British Isles, much new land is being enclosed, and often, in the area selected, the available arable land is insufficient to meet the demand and grassland is used. In these circumstances, considerable losses may be caused during the first few years by the presence of wireworms, the activity of which may be responsible for the death of large numbers of tomato plants. In one case which recently came to the writers' notice, out of 2,196 tomato plants set out in wireworm-infested soil of a new nursery, 580, or 27 per cent., were destroyed by wireworms.

Wireworm Content of Grassland.—Grassland is well known to harbour considerable numbers of wireworms, as instanced by the following figures representing calculations of the number of wireworms per acre in the case of three grass fields in Shropshire examined by Roebuck,* 215,000, 350,000, and 510,000. In the case of a field in Lincolnshire, examined within a year of being ploughed out of grass, 83 samples, each 6 in. square and 9 in. deep, were found to contain 81 wireworms, or approximately 170,000 per acre. The soil in three glasshouses to be used for tomato culture has recently been sampled for wireworms, with the following results :—

House	No. of samples	Size of sample	Wireworms present	Calculated wireworms per acre
A	40	6in. dia. 18in. deep	37	205,000
B	64	6in. dia. 18in. deep	57	197,000
C	10	6in. sq., 12in. deep	9	156,000

Species concerned.—At the time of writing, two types of wireworms have been taken under glass : the *Agriotes* type, and the *Athous* type ; and beetles of two species have been observed about the glasshouses: *Agriotes obscurus* and *Agriotes sputator*.

Baiting for Wireworms.—The question of using baits to attract wireworms has recently been dealt with in America by Spuler (1925) (*Journal Econ. Entomology, Vol.* 18, *page* 703), who found that a number of baits could be successfully employed. The results obtained by this investigator showed that a system of baiting, coupled with the use of an effective soil insecticide, afforded a satisfactory means of dealing with wireworms.

It was decided to investigate the possibilities of using this method in England, and accordingly experiments in baiting were carried out by the writers in Lincolnshire in October and November, 1925, various baits being employed. The bait substances were drilled or set in rows in the order given below ; the rows were 30 ft. long and 5 ft. apart, and after fourteen days were examined for wireworms attracted. Table I gives the results obtained.

The total number of wireworms attracted to each bait substance gives an indication of the order in which the baits were preferred. These figures are given in Table II.

* Board of Agriculture (1920) Miscellaneous Publications, No. 23, page 9.

TABLE I

Row No.	Bait	Depth in inches	Wireworms attracted
1	Chopped potatoes ..	4	41
2	Oats	2—3	89
3	Wheat	2—3	88
4	Chopped potatoes ..	3	24
5	Beans	2—3	51
6	Peas	2—3	33
7	Potatoes	2	15
8	Grass	4	34
9	Oats	2—3	32
10	Wheat	2—3	46
11	Grass	3	55
12	Beans	2—3	41
13	Peas	2—3	42
14	Grass	2	37
15	Bran	4	64
16	Oats	2—3	38
17	Wheat	2—3	47
18	Bran	3	52
19	Beans	2—3	34
20	Peas	2—3	62
21	Bran	2	47

TABLE II

Bait	Wireworms attracted
Wheat	181
Bran	163
Oats	159
Peas	137
Beans..	126
Grass	126
Potatoes	82

Having obtained the information that under native conditions the wireworms were attracted to the baits in some numbers, it was thought advisable to test the speed with which the baits acted. Accordingly, a second series was laid down, and the baits already selected (with the exception of grass) were again used. The rows, each 20 yards long, were set in duplicate, and one yard samples were examined on the days shown.

Table III summarizes the results of the trial, which indicated that bran attracted wireworms most speedily, but that wheat and oats increased in attractiveness over a longer period. An interesting feature of these trials was the very definite attraction germinating seeds exercised on the wireworms, a fact not hitherto recognized in this country.

The distance apart at which to set bait rows for maximum efficiency is important, and, in order to determine the most suitable distances, rows of wheat were used. The results obtained from this trial were inconclusive. It was, however, thought that for glasshouse work it would be inadvisable

TABLE III.—ATTRACTIVENESS OF WIREWORM BAITS

Bait	Dates of examination of baits											Total first twelve days	Dates of examination of baits										Total second twelve days	Total for period
	October												October						November					
	13	14	15	16	17	19	20	21	22	23	24		26	27	28	29	30	31	2	3	4	5		
		W I	R E	WO	RM	S	A T	T R	A C	T E	D		W I	R E	W O	R M	S	A T	T R	A C	T E	D		
Bran ..		4	3	2	6	6	6	10	9	9	11	66	2	5	4	1	2	0	1	0	0	1	16	82
Oats ..		6	1	1	2	2	3	2	6	6	2	31	19	1	15	11	5	22	14	5	1	2	95	126
Wheat		7	1	0	2	9	7	10	12	6	5	59	3	5	1	2	2	9	8	6	8	11	55	114
Peas ..		1	2	3	2	1	4	4	12	7	4	40	4	2	2	3	2	7	2	14	3	4	43	83
Beans ..		4	2	1	1	7	1	1	4	5	3	29	1	0	1	4	0	9	4	6	5	9	39	68
Potatoes		1	0	1	0	1	2	6	16	10	7	44	2	2	0	0	2	4	4	4	3	4	25	69
Bran ..		4	2	2	12	9	5	17	7	10	3	71	4	0	2	3	3	2	2	0	1	2	19	90
Oats ..		2	2	1	2	11	4	3	9	8	5	47	4	1	8	8	3	20	8	14	12	17	95	142
Wheat		2	5	4	3	8	5	7	6	15	8	63	14	6	2	7	7	17	12	17	12	8	102	165
Peas ..		6	1	2	4	2	3	8	13	5	6	50	6	4	7	6	6	2	9	6	4	7	57	107
Beans ..		2	1	3	6	6	2	13	6	7	5	51	6	3	2	5	5	3	0	4	0	10	38	89
Potatoes		3	3	1	4	6	4	4	5	13	3	46	6	2	6	2	5	8	2	2	1	3	37	83

to set bait rows farther apart than four feet. The figures obtained are given in Table IV.

TABLE IV

Bait	Row No.	Distance apart in feet	Wireworms attracted	Wireworms in inter-space	Percentage attracted
Wheat ..	1	—	11	—	—
	2	2	15	1	94
	3	3	6	1	86
	4	4	10	1	91
	5	5	8	4	67
	6	6	11	8	58
	7	7	12	2	86
	8	8	12	7	63
	9	9	27	4	87
	10	10	25	4	86

The results of these experiments showed that wireworms could be readily attracted to suitable baits, but that baits showed considerable variation in attractiveness. The numbers assembled at the baits indicated that baiting in conjunction with a suitable insecticide might prove a useful control measure for wireworms in areas where intensive culture was followed, or in glasshouses.

Trials in Glasshouses.—The most efficient baits, as determined by the foregoing trials, were selected for use in wireworm-infested glasshouses, and in order to test their efficiency under glass, as compared with that of other substances easily obtainable and also possibly suitable for the purpose of baiting, duplicate series of trials were laid down in a new glasshouse, which carried its first crop of tomatoes in 1925. As a result of systematic sampling, the soil was estimated to have a wireworm content of 205,000 wireworms per acre. The baits selected were wheat, castor meal, brewers' grains, rape meal, bran, and rape cake dust; portions of each bait were set in holes 3 in. deep, made with a bulb planter, and covered with about an inch of soil. The baits were set in duplicate series, in rows 2 ft. apart, and 2 ft. apart in the rows; *i.e.*, one bait set per 4 sq. ft. Each series consisted of 30 bait sets.

The baits were set on December 9 and 10, 1925, when the soil temperature was as low as 36° F. and the air temperature 32° F. in the house, and, although weekly examinations were made, it was not until January 4, 1926, when the soil temperature had risen to 47° F. and the air temperature to 55° F., that wireworms began to assemble at the baits. Table V gives a summary of the results obtained, and from this it will be seen that wheat proved to be by far the most efficient bait :—

TABLE V

Date 1926	No. of sets examined per bait	Bait Substance					
		Wheat	Castor Meal	Brewers Grains	Rape Meal	Bran	Rape Cake Dust
		Wireworms assembled					
Jan. 19	3	9	8	12	7	4	1
„ 21	7	24	0	5	10	1	8
„ 26	11	16	10	16	11	9	6
Feb. 1	1	9	1	0	2	0	1
„ 2	11	106	34	16	20	15	17
„ 4	12	105	8	12	14	14*	23
„ 5	3	34	4	4	1	8	0
„ 9	12	125	8	20	6*	17	7
		428	73	85	71	68	63

* From eleven bait sets only.

Baiting and Calcium Cyanide for Wireworm Control.—Based on these results, a large glasshouse, having an estimated wireworm content of 197,000 wireworms per acre, was drilled on February 3, 1926, with alternate rows, 175 ft. long, of wheat and brewers' grains. The house accommodated ten rows, rows 1 to 6 being 2 ft. apart and rows 6 to 10 being 3 ft. apart. The bait was set 2 to 3 in. deep. The soil was rather cloddy and a considerable amount of decaying turf still remained. On the day the baits were drilled, the air temperature at midday was 54° F. and the soil temperature 48° F. After the bait was drilled, gentle heat was turned on in the glasshouse, and in a fortnight it was found that the wheat had germinated well, and considerable numbers of wireworms had assembled in the rows. Commercial calcium cyanide, in granular form, containing from 40 to 50 per cent. of pure calcium cyanide, was applied in varying quantities to the bait rows on February 17, *i.e.*, a fortnight after the bait was drilled. The calcium cyanide was applied by means of a "Planet Junior" hand drill, fitted with a deep plough attachment, rendering it possible to deposit the material at a depth of about 4 in., that is, just below the level of the bait. Since the soil was rather cloddy, it was necessary to pull the soil displaced by the drill back over the rows. The drill followed the bait rows closely; this was rather difficult in the case of brewers' grains, but quite easy in the case of wheat, the green shoots making it possible to apply the material actually in the rows. The wheat was speedily destroyed by the calcium cyanide, which taking moisture from the soil gave off hydrocyanic acid gas.

Six days after treatment with calcium cyanide, representative samples, each 1 yd. in length, 4 in. deep and 6 in. wide, were taken along the bait rows and the soil sifted for wireworms, when those destroyed by the calcium cyanide were read.ly distinguishable from live specimens by their elongated and rather swollen condition. The following is a summary of the results obtained :—

TABLE VI

Row No.	Bait	Yards Examined	Wireworms					Percentage killed
			lb. Cyanide per row	Alive	Dead	Comatose	Total	
1	Wheat	7	nil	107	0	0	107	
2	Brewers' grains	6	3½	6	12	2	20	60·1
3	Wheat	7	3	63	30	3	96	31·2
4	Brewers' grains	6	2½	6	18	1	25	72·0
5	Wheat	5	2	13	39	7	59	66·1
6	Brewers' grains	5	2	12	1	7	20	5·0
7	Wheat	6	2½	30	69	8	107	64·4
8	Brewers' grains	5	3	9	22	2	33	66·6
9	Wheat	6	3½	22	58	6	86	67·4
10	Brewers' grains	5	nil	8	0	0	8	

From these figures it is seen that 31 yards of wheat attracted 455 wireworms, or 14·67 wireworms per yard, while 27 yards of brewers' grains attracted 106, or only 4 wireworms per yard. The figures representing the percentage of wireworms killed are interesting, and, except in the cases of the 3 lb. dressing of calcium cyanide to wheat and the 2 lb. dressing to brewers' grains, the figures vary from 60 to 70 per cent., indicating that calcium cyanide used at rates between 2 lb. and 3½ lb. per 175 yd. gives a fair measure of control.

In order to determine whether the method could be reasonably adopted on a commercial scale, a glasshouse heavily infested with wireworms was tested in the Worthing area. Wheat only was used as a bait and drilled in rows 2 ft. apart, 2 to 3 in. deep, on February 24. The house was gently heated and, on March 3, 8 yd. of bait row examined yielded a total of 194 wireworms, indicating that the insects were being speedily attracted. Subsequently, on March 10, a fortnight after baiting, calcium cyanide at varying rates was applied in

the manner already described, the rows of bait being very carefully followed with the drill. On March 15 and 16, six and seven days after treatment, representative yard samples were sifted out and the wireworms collected for examination, when the following figures were obtained:—

TABLE VII

Calcium cyanide used per 150 ft. of bait row lb.	Length of bait row examined yards	Wireworms Alive	Dead	Total	Percentage wireworms killed
$\frac{3}{4}$	6	65	117	182	64·28
1	6	51	195	246	79·26
$1\frac{1}{4}$	6	22	111	133	83·45
$1\frac{1}{2}$	6	9	144	153	94·11
$1\frac{3}{4}$	6	12	149	161	92·54
2	6	19	141	163	86·50
$2\frac{1}{2}$	6	0	151	151	100·00
nil	6	232	0	232	nil

The soil at Worthing was much finer and freer from clods than the soil at Hatfield; the drill ran better and a more even distribution of the calcium cyanide resulted, which may account for the higher percentage of wireworms destroyed. In the 48 yd. of bait row examined, a total of 1,189 wireworms were assembled, or an average of 29·19 per yard; on an area basis, therefore, this particular glasshouse, 50 yd. long and 27 ft. wide, would contain a matter of 18,000 wireworms, or approximately 198,000 per acre.

In addition to the wireworms attracted to the bait rows, numbers of click beetles also assembled in the vicinity of the bait, possibly attracted by the moisture about the young plants; in sifting out, numbers of the dead beetles were obtained, in some cases as many as ten click beetles in a yard sample. The particular species obtained were *Agriotes obscurus* and to a less extent *Agriotes sputator*—the two species which also commonly occurred amongst the baits at Hatfield.

General Conclusions.—Experiments at Boston, Hatfield and Worthing indicate that wireworms are readily attracted to suitable bait substances, and, out of a number of baits selected for trial, germinating wheat has proved by far the most efficient. Drilled in rows 2 to 4 ft. apart, wheat attracts a considerable proportion of the available wireworms in a fortnight to three weeks, depending largely on soil temperature. Calcium cyanide used at the rate of from $1\frac{1}{2}$ to $3\frac{1}{2}$ lb. per 180 ft., in conjunction with a suitable system of baiting, yields a good measure of control. The cost of granular calcium cyanide is about 1s. 3d. per lb., and to treat a house 150 ft. long by 27 ft. wide, drilling 12 rows of bait 2 ft. apart and applying $2\frac{1}{2}$ lb. of

calcium cyanide per row, would need 30 lb. of material, costing 37s. 6d.

Results obtained in these experiments indicate that the finer the soil the more effective the treatment, and the nearer the middle of the bait rows the calcium cyanide is deposited the higher the mortality amongst the assembled wireworms.

In conclusion, our thanks are due to Mr. Frank Waite of Boston, Mr. Ivor Mard of Hatfield, and Mr. Yates-Christie of Worthing, for their kindness in placing land or glasshouses at our disposal for the investigation.

SEAKALE CULTIVATION

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THE seakale (*Crambe maritima*) is one of the cruciferous natives of the seashore. In this country it has been found growing wild at such widely distant places as Weymouth, Lulworth Cove, Beachy Head, Carnarvon and the Westmorland coast. In the wild state, its natural soil is sand, but it is recorded that it has been found growing abundantly and well in loamy soils mixed with gravel, and in stiff loams, near Dover.

The plant has thick fleshy leaves and a large perennial rootstock, the leaves varying in colour from green to a beautiful glaucous hue. When covered up, the leaf stalks become blanched, tender and succulent, and are much esteemed as an article of food.

As a commercial crop, seakale is grown for three definite ends :—

(*a*) For the production of large crowns for sale for forcing.
(*b*) For the production of crowns for home forcing.
(*c*) For the production of the natural crop in the open.

Soils.—The crop may be grown well in most fertile soils, but the best results are obtained on a deep sandy loam. The best crowns for forcing are produced on fairly heavy loam, but here there is the serious disadvantage that lifting operations are difficult. The primary considerations are that the soil should be well drained, and that it should be deeply worked before laying down the plantation.

Preparation of the Land.—The land must first of all be ploughed deeply and the subsoiler used in the furrow. For smaller areas, bastard trenching will serve the purpose quite

well. In either case, the breaking up of the soil to a uniform depth of at least 18 in. is required.

Before planting the young sets, the land must be brought into good heart by liberally manuring the previous crop with farmyard manure. A mixture of 4 cwt. of superphosphate of lime, or a like amount of pure dissolved bone, and 1½ cwt. of sulphate of potash should be given per acre and worked lightly in just prior to planting.

It is important that the land should not be deficient in lime, and, where necessary, 10 cwt. of ground lime per acre should be applied to the ground and worked in some time before manure is applied.

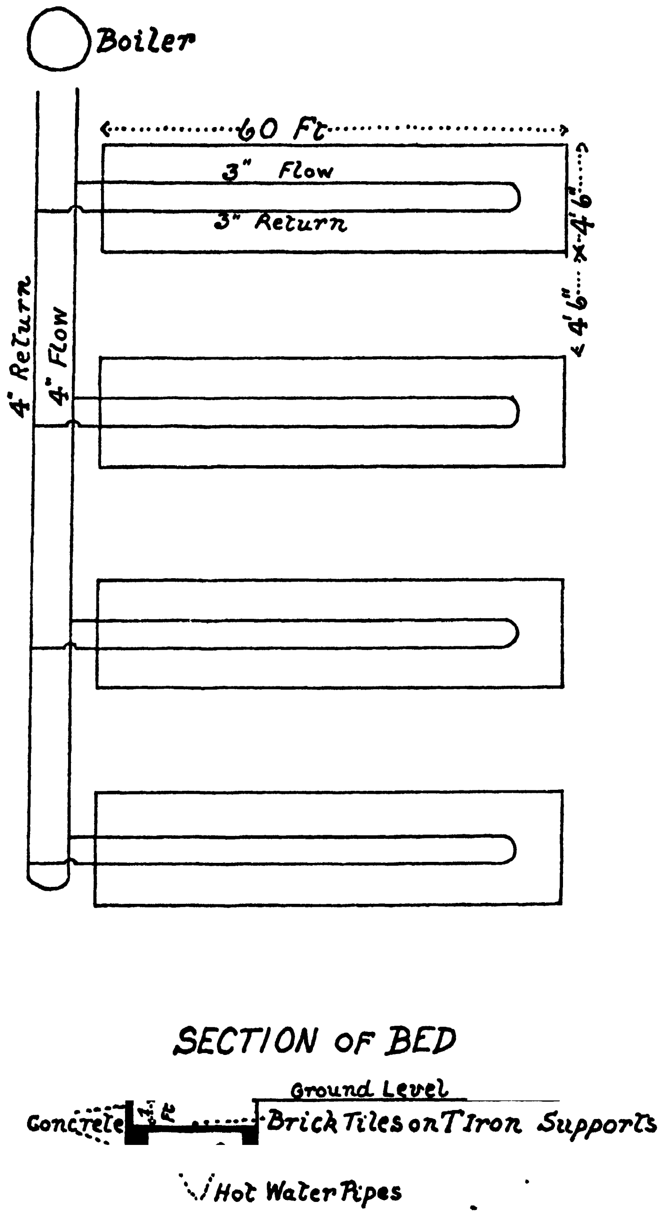
Propagation.—The usual method of propagation of seakale is by division of the root, the lateral root branches being cut off and trimmed into lengths of from 3 in. to 6 in. Where crowns are to be raised for sale to the trade for forcing, it is advisable to cut the thongs about 6 in. long. The end nearest the main root, which will in time produce buds, should be cut square, and the other end cut slantwise. These thongs are then tied up in bundles and stored in sand until they are required for planting, some time in March. Where there are several buds, all but the largest one, or in some cases two, should be rubbed out prior to planting. Alternatively, the sets may be cut square at each end and then spread out in thin layers in beds of light soil. The beds should be 3 ft. 6 in. wide, and should be made by casting up the soil at the sides over the sets so that there may be about 3 in. of soil over each layer. Three or four layers may be put into a bed.

When the sets are struck they can be forked out and put into receptacles for planting. It will be easy to distinguish which end is the crown and which the root. Disbudding may be left until July, and the kale suckered to a single crown by means of a knife or spud.

Stock may also be raised successfully from seed, but the crowns will not yield first-grade produce in the year following sowing. The beds may be covered by about 6 in. of soil, and as soon as the foliage shows through this covering it should be cut with the crown attached. The roots may then be dug up and planted as sets in the usual way.

Planting and Treatment.—The sets are planted during March or April at 12 in. to 15 in. apart, with 18 in. between the rows. Firm planting is essential, and the tops of the sets must be covered by at least 1½ in. of soil.

The treatment of new plantation consists mainly in keeping



A typical example of Forcing Pits.

down weeds by constant horse- or hand-hoeing, and in keeping the surface soil loose. As a rule, no artificial manures are given, but some growers favour the application of ½ cwt. nitrate of soda, and not more than 1 cwt. of salt, during the growing season. Soot, applied at the rate of 20 bushels to the acre, preferably during slight rain, is beneficial to the crop.

Forcing.—Lifting of the roots for forcing usually begins towards the end of November. The roots are ploughed out, or, on the smaller places, dug up, and the lateral roots trimmed off, leaving only the main root and the crown or terminal buds. The lateral roots which have been cut off are trimmed and stored for planting in the manner outlined above.

The forcing process is usually carried out in sunken pits, from 4 to 6 ft. wide, 2 to $2\frac{1}{2}$ ft. deep and of varying length. A typical system of forcing pits is shown in the accompanying diagram.

On the larger places, the pits are heated by hot water pipes. Over the pipes are placed T iron supports, on which is laid a single layer of brick tiles. On the tiles, soil is placed to a depth of 10 in., and on this the kale crowns are planted in rows at 3 in. intervals. The crowns are thoroughly watered and boarded in, and over the boards is laid some 6 in. of strawy manure. During the forcing period no further watering is required. A temperature of from 50 to 60 degrees F. should be maintained, and on no account should the latter temperature be exceeded. The slower the forcing, the more tender will be the kale. The first cutting will be ready about four weeks from the commencement of forcing, but later in the season the forcing period will decrease considerably.

When the first crowns have been exhausted, the beds may be cleared, and a further lot planted.

For forcing with hot fermenting manure, throw up a bed 4 ft. wide and 2 ft. 6 in. high, by digging a trench on each side, facing the sides of the bed straight by the back of the spade. Plant the kale crowns across the top of the bed, in rows, 3 in. apart, as for hot water forcing. With a bent crowbar make holes into the bed 1 ft. from the top—on each side, but so that the holes are not opposite each other. Fill the trench each side with manure, taking care to shake it well up. Cover the crowns of kale with mats or sacking and 6 in. of light straw litter. The manure will need shaking and making up with some fresh material once a fortnight. Care must be taken to keep the edges of the bed packed with litter, or the air will get in as the kale lifts the covering.

Natural Seakale.—Following forced seakale in season comes the " natural " crop, grown in the open. The beds are covered by 9 in. of soil, and harvesting commences as soon as the plants show through this covering.

Marketing and Harvesting.—Forced seakale has a season extending from early January to the end of March, and is

then followed in the market by the natural crop. The first cutting is confined to the most forward stalks, and is taken when these are about 6 in. long, further cuttings following in due course. The stalks are trimmed and are generally packed in boxes holding 8 lb. net weight, or punnets holding from 2½ to 3 lb. of kale are sometimes used.

Varieties.—Practically all the commercial stocks of this vegetable are of the *Lily White* variety, but there is much variation in the productive power of different stocks. The only way to ensure a good strain is by rigorous selection, by which means all the best growers have built up their stocks.

s.—Seakale is subject to a bacterial disease known as black rot, which is associated with bad soil conditions, and for this reason sub-soiling prior to planting, and thorough drainage is imperative. The land must also be kept well supplied with lime. In propagating by thongs, care should be taken to see that all thongs which show black threads in the cut tissues are rejected. Seakale is also sometimes attacked by club root or finger toe disease, but only when the soil is deficient in lime.

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1926

Produce of Potato and Root Crops.—Preliminary statement showing the estimated total produce and yield per acre of the potato and root crops in England and Wales in 1926, with comparisons for 1925, and the average yield per acre of the ten years 1916-25.

CROPS	ESTIMATED TOTAL PRODUCE		ACREAGE		ESTIMATED YIELD PER ACRE		
	1926	1925	**1926**	1925	**1926**	1925	AVERAGE OF THE TEN YEARS 1916–25
	Tons	Tons	Acres	Acres	Tons	Tons	Tons
Potatoes	**2,763,000**	3,214,000	**499,419**	493,241	**5·5**	6.5	6.1
Turnips & Swedes	**10,976,000**	9,198,000	**766,502**	805,486	**14·3**	11.4	12.4
Mangolds	**7,109,000**	7,130,000	**338,160**	357,985	**21·0**	19.9	19.1

POTATOES.—The detailed estimates of the yield per acre of potatoes confirm previous forecasts that this year's crop is well under average in most parts of the country. Over the whole of England and Wales the yield per acre is only 5½ tons, or three-fifths of a ton below the ten years' average, and one ton less than in 1925. The worst crops are in the Isle of Ely, where the yield averages only 3½ tons per acre, or a little more than half the ten years' mean for that county, while Huntingdon with a yield of only 3¾ tons has a deficiency of 2¼ tons per acre. Yields are more than one ton per acre below average in Norfolk and Lincoln (Holland). In the north and south-west of England and in Wales about average crops have been obtained on the whole, but results vary a good deal in the different counties. Lancashire, Cheshire and the West Riding of Yorkshire have lifted crops a little above their respective averages.

The total production on agricultural holdings in England and Wales is estimated at 2,763,000 tons, or 450,000 tons less than in 1925, and much the same as the short crops of 1923 and 1924, when the total production in England and Wales was 2,758,000 tons and 2,696,000 tons respectively. There was a good deal of disease among the crop in the eastern counties, and the tubers are generally small throughout the country, but the crop was clamped in clean and dry condition.

TURNIPS AND SWEDES.—In practically all parts of the country yields per acre of turnips and swedes are well above average, the only exceptions being Devon and Cornwall and a few counties in Wales and the extreme north-west of England. The northern counties on the eastern side of the country have exceptionally heavy crops, each county from Northumberland to Lincoln (Lindsey) growing from three to four tons per acre more than their ten years' averages. The yield per acre over the whole country is estimated at 14·3 tons, or nearly two tons per acre above average and, apart from 1920, when a similar yield was obtained, is the heaviest since 1910. The total production of 10,976,000 tons is 1,780,000 tons greater than in 1925.

MANGOLDS.—Yields per acre of mangolds are also well above average, and best in the eastern half of the country. Both the eastern and north-eastern counties had crops more than 2½ tons per acre above average, with even better crops in the most northerly counties from Northumberland to Yorkshire. A few of the counties in the north-west and south-

west of England and in Wales had under-average crops. The yield over the whole of England and Wales, which is estimated at 21 tons per acre, is nearly two tons above the decennial average, and is the heaviest of the last eight years, but the total production of 7,109,000 tons is about 20,000 tons less than last year owing to the reduction in acreage of about 20,000 acres.

WINTER KEEP.—The supplies of winter keep are ample in practically all districts. Not only are there very good crops of roots in most areas, but hay crops were also above average.

SUGAR BEET.—Estimates which have been obtained of the yields of sugar beet suggest that the yield per acre is heavier than last year, and will average between eight and nine tons of washed and topped roots. Last year a crop of practically eight tons per acre was obtained. The total production of sugar beet this year is likely to be rather over 1,000,000 tons against 428,000 tons last year, the area having been increased from 54,750 acres to 125,800 acres. About four-fifths of the total crop is grown in the eastern and north-eastern counties.

JANUARY ON THE FARM

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Review.—The name of the first month of the year was originally given in honour of the Roman deity Janus or Dianus, who was believed to preside over the beginning of all business and was represented as having two faces, one looking backwards and the other forwards. At this time of the year in particular farmers also look both backwards and forwards, and as regards the coming season endeavour to organize their business so as to take advantage of, or avoid the disadvantages of, any changes in values and conditions which recent tendencies may seem to indicate.

For many years, excepting the abnormal period of the European War, the predominant tendency in British agriculture has been the displacement of arable cultivation by grass farming, and the extension of winter milk production at the expense of winter fattening of cattle and sheep. Owing to recent tendencies in values, however, many farmers are now beginning to wonder whether it is still wise to "follow the crowd" in the direction above indicated; and, the question having been raised as to the possibility of a world shortage of

bread corn in the not very distant future, the trend of prices of wheat is being watched with considerable interest.

It is not now so clear that grass-land farming is a means of escape from financial troubles in agriculture. Cost accounts which are being kept by economists on the staffs of agricultural institutions do not, in some districts at least, lend encouragement to the grassing-down policy ; and, apart from cost accounts, recent market conditions have given the grassland farmer cause for concern. The rearer and grazier of store cattle has, during the past few years, had the disadvantage of selling out at the end of the grazing season on a falling market. This fall is shown by the index numbers, which represent the percentage increase on the prices ruling in the corresponding months in 1911-13 :—

	Store Cattle		Store Sheep	
	April	November	April	November
1924	38	36	84	94
1925	39	32	100	68
1926	31	22	60	42

With fat cattle sold in March and April, however, the changes have been in the opposite direction, to the obvious advantage of the arable farmer who bought the stores for winter fattening : the index figure for fat cattle in March, 1926, was 43, or an advance of 11 per cent. on the price of stores in the preceding November.

Another circumstance is causing farmers to wonder as to the possibilities of arable cultivation, namely, the difficulty of finding a market for milk. In districts not well situated for direct sale of liquid milk large quantities are being sold at less than 12d. per gallon, and in other districts surplus milk is being disposed of at similar or lower figures.

With regard to the prices of corn, attention may be drawn to the favourable position which wheat prices have maintained during the past three years. In November, 1926, the average price of British wheat was 12s. 5d. per cwt.—almost the same as in November, 1924—as compared with 7s. 6d. per cwt. in 1911-13 : the index figure for November, 1926, was 66. At the price mentioned it is not disputed that, under suitable conditions, wheat growing allows of a fair profit and that, if there were grounds for confidence in the maintenance of a price of 12s. 6d. per cwt., farmers would continue to extend their acreage. The position with regard to barley and oats, however, is not so favourable. Potatoes have been erratic in values, but on the whole not unfavourable, while sugar-beet growing at present prices is so attractive that the acreage tends to increase beyond the capacity of the factories.

On the costs side the figure for labour is about 70 per cent. above pre-war level, a consideration in favour of grass-land farming other than milk production. Fertilizers, however, are now almost down to 1914 prices. Certain sources of nitrogen are even cheaper than in 1914, and, with the possible development of Continental competition, may continue to fall. As nitrogen is such an important aid to profitable corn production where stiff-strawed varieties are adopted, the importance of this consideration should not be underestimated.

Seasonal Operations.—Farm work in January comprises the following groups of operations :—Attention to milking, fattening and store stock, which are under cover ; care and feeding of cattle wintering out and of sheep on grass and on roots ; thrashing of grain ; boxing of seed potatoes ; carting manure on to grass land or on to land ploughed for roots ; ploughing of leas and cross ploughing stubbles ; slagging pastures ; hedge-laying ; draining, water-furrowing and road-mending ; and, as opportunity affords, drilling of wheat and other cereals. The list is therefore comprehensive, and with good organization and direction much may be done by way of preparation for the busier time which commences when the land begins to assume a dry face in February or March. The question of whether cattle should receive their roots whole or pulped and mixed with straw chaff and meals may be determined by the possibility of making better use of the labour in other work of a more definitely necessary kind. Where chaffing, pulping and mixing are adopted, so much time may be absorbed by this work that little opportunity may be found for outdoor work.

Sheep on Turnips.—The folding of sheep on roots is one of the most characteristic features of British arable farming. It was the introduction of this practice that led to the reclamation of extensive areas of light land in Norfolk, Yorkshire, Lincolnshire and Northumberland which had previously not been capable of cultivation with profit ; and down-land arable farmers are emphatic as to the necessity for sheep folding as a means of maintaining the fertility of their soils.

In recent years few experiments have been carried out for the purpose of determining the value and use of new feeding stuffs in this connexion, and the farmer who wishes to criticize his methods must acquaint himself with the results of findings which are 20 or more years old. In the *Transactions* of the Highland and Agricultural Society of Scotland, 1909, Ingle reviewed the results of 194 lots of experimentally fed

sheep, and perhaps the most outstanding lesson brought out was the virtue of roots. The rate of gain increased with the quantity of roots fed, up to a maximum weekly increase of 2.33 lb. per 100 lb. of live weight, when the quantity of roots fed per 100 lb. live weight increased to 125 lb. Many lots of sheep received more than 125 lb. per head per week and made weekly gains considerably higher than 2.33 lb., but they were for the most part sheep of more than 100 lb. live weight.

Clover hay was also found to have a favourable effect on the fattening process at a low cost in nutriment, being superior to meadow hay. Ingle attributes this superiority to the influence of its ash constituents. The favourable influence of minerals in the ration of fattening sheep has been confirmed in experiments recently conducted by the Rowett Institute, but the results with breeding ewes were not such as to favour the use of minerals for this class of stock until further information is available.

As regards the concentrates to be fed with roots and hay, practice strongly favours linseed cake, and it must be admitted that the results of the experiments reviewed by Ingle confirm the high opinion which this cake has gained. As a standard ration per 100 lb. live weight per week, it is difficult to name one that will produce more rapid gain than 100 lb. roots, 3 lb. clover hay and 5 lb. linseed cake.

In January the sheep are on swedes and the best flock masters are in favour of cutting the roots and feeding them in troughs. This opinion is attributable not only to the fact that the hoggs are passing through dental changes, but also because clean food fed out of boxes saves life. The best results are obtained where it is practicable to divide the sheep into separate smallish lots of about 100 each and to arrange these according to forwardness of condition. The concentrates are fed twice a day—first thing in the morning before the roots and again in the middle of the afternoon. The hay rack is replenished every afternoon and the troughs are left full of cut roots at night. Some feeders serve the concentrates mixed with hay or straw chop for two reasons: it prevents the master sheep from rapidly clearing more than their fair share of the richer food, and consumption of fibrous fodder when on heavy root rations corrects the laxative tendency of the roots without the use of the relatively expensive cotton cake.

The management of sheep on roots entails consideration of the proper distribution of the manure produced by the sheep, which is ensured by systematic movement of the folding nets

or hurdles and feeding troughs. In wet weather and on soils that are not benefited by the folding of sheep under such conditions, it is advantageous when the sheep can be transferred to an adjoining lea field to which the turnips can be carted. Here, however, somewhat close folding is desirable, as unlimited range has been demonstrated not to be conducive to rapid fattening.

January Sowings.—Owing to the wetness of November and the comparatively small acreage of winter corn which it was possible to sow in the autumn, it is likely that special endeavours will be made to drill wheat whenever possible in January. For this purpose reliance should be placed on varieties which have been found by actual trial to be suitable for this purpose: some are not suitable, but in the writer's experience standard red, Squarehead's Master, bearded red (not Rivett's) and Victor have all been found capable of yielding well after January sowing. The application of a few cwt. of artificial fertilizer containing some nitrogen, however, has been found to assist the crop very materially. The drilling should be as shallow as is practicable, having regard to the necessity for hiding the seed from birds. The general practice will doubtless be to devote the first opportunities to the sowing of wheat, for winter oats and spring oats and barley may be sown after the proper time for wheat sowing has passed.

Seed Potatoes.—The buyer of seed potatoes is gradually beginning to understand that the virtues of change of seed are attributable to the comparative freedom of approved new seed from virus diseases rather than to the change from one class of soil or type of climate to another. Seed can now be obtained which has been grown under the supervision of qualified inspectors whose duty it is not to recommend the official certificate in respect of crops that are not free from leaf roll or that contain more than a low percentage of mosaic disease. Whether to extend the area of potatoes must be left to each grower's judgment. It must be borne in mind, however, that during 1925 and 1926 increased acreages were cultivated, and that in 1926 the indications were all in the direction of low prices until disease appeared and reduced the prospects of a satisfactory yield. On the other hand, it would not be safe to apply too literally the rule not to buy dear seed potatoes.

NOTES ON MANURES FOR JANUARY

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Secondary Effects of Manures.—Manuring is usually regarded as a means of supplying plant food to the soil, the success of the operation being estimated by the increase in yield obtained. In most cases, however, the action of manures is not so straightforward as this view might suggest. Apart from increasing the crop, fertilizers may exert a number of other effects both on the plant and on the soil, and these actions should receive consideration when framing a manurial scheme. The crop may be affected in the following respects :—

(1) *Quality.*—Heavy applications of nitrogenous manures, unbalanced by sufficient phosphate and potash, tend to raise the nitrogen content of barley, thus lowering the malting quality ; to depress the sugar content of beet ; and to injure the keeping qualities of potatoes. Chlorides, supplied in the form of common salt in the low-grade potash manures, may result in inferior cooking quality in potatoes, the effect being most marked in the absence of farmyard manure. There is evidence that phosphates and, in some cases, lime increase the feeding value of pasture.

(2) *Maturity.*—The effect of phosphates, in giving the root crop a good start and helping the ripening process in the case of cereals, is well known. Nitrogenous manures also favour early growth, but, if used in excess, the plant tends to keep on growing too long and is late to mature. There is thus a risk of losing harvesting weather for the cereal crops.

(3) *Habit of Growth.*—All-round manuring gives sturdy plants with a normal balance between their vegetative and reproductive parts. Nitrogen favours the development of the former, phosphate the latter. An excess of nitrogen may be in place for crops grown for leaf or stem, such as some of the root crops, but is dangerous for cereals.

(4) *Disease.*—As far as diseases in early life are concerned, such as the attacks of turnip flea beetle, mangold fly, or gout fly of barley, any fertilizer treatment tending to hasten the young plant past its vulnerable stage is of value. Many fungus diseases are said to be favoured by the soft, sappy growth induced by one-sided nitrogenous manuring, while the use of potash fertilizers helps the resistance of the plant. This is well seen in the control of the stripe disease of tomatoes by the liberal use of potash.

Turning now to the effects of fertilizers on the soil, we have to take account of possible changes in :—

(5) *The Chalk Supply.*—Certain fertilizers, notably basic slag and cyanamide, contain appreciable quantities of calcium compounds which are basic in their action, *i.e.*, they are capable of neutralizing acidity in the same way as are chalk and lime. Their use thus tends to improve the lime status of the soil, but in the quantities ordinarily applied they cannot be regarded as substitutes for lime when land is markedly acid. The opposite action is shown by certain manures of which sulphate of ammonia is the best example. Here a certain amount of chalk is used up in the transformations which this substance undergoes in the soil. The effects above noted are cumulative rather than sudden or drastic, and the amounts of base involved are small in relation to the gain by straightforward liming on the one hand or the loss by drainage on the other.

(6) *The Texture.*—The beneficial effects of dung and lime on the workability of soil are outstanding. While artificial fertilizers, used in ordinary quantities, do no harm to the texture of soils, it has been observed that heavy dressings of salts of soda or potash sometimes cause clays to run together and work badly. Where experience shows that this is the case, high-grade potash salts should be given the preference over the less concentrated manure salts, and sulphate of ammonia may be used as a substitute for nitrate of soda.

Sewage Sludge.—Considerable study has been devoted to the problem of realizing the manurial value of the sewage sludges which are produced in large quantities in inland towns. The problem presents two difficulties, firstly, the sludge itself contains a very high percentage of water, the removal of which is troublesome and expensive ; and, secondly, the nitrogen, which is the main manurial constituent, is in most cases resistant, *i.e.*, slow acting, from the farmer's point of view. Ordinary sludges from settling tanks or precipitation tanks contain about 1·2 per cent. of nitrogen, reckoned on the dry matter, and this nitrogen is only slowly available. If lime has been used in the precipitation processes, this gives a little extra value to the sludge. Wet sludges are exceedingly difficult to handle and find no favour with farmers. When some of the water is removed by pressing, the material can be disposed of in the neighbourhood of the works. Its value lies as much in the physical effects of the large dressings applied as in the

fertilizing action of its constituents. In order to facilitate the disposal of these materials, they may be more completely dried and possibly enriched by the addition of other wastes of higher analysis and greater availability. In recent years the activated process of sewage purification has come into prominence in the United States and in some towns in England. The resulting sludge is relatively rich in nitrogen, from 5 to 7 per cent. on the dry matter, and contains appreciable quantities of phosphate in addition. Experiments have shown that the nitrogen is distinctly more active than that of the ordinary sludges and is converted into nitrate in the soil at about half the rate of the nitrogen in dried blood. In the wet state, activated sludge contains about 98 per cent. of water, which is unfortunately more difficult to get rid of than in the case of ordinary sludges. When sufficiently dry to handle it forms a valuable and active nitrogenous manure. The sludge from the slate-bed purification process and the so-called humus which is washed out of percolating filters are intermediate in their analysis and availability between the two types previously mentioned.

Ground Limestone.—With regard to the fineness of grinding of limestone or chalk for agricultural purposes, there are two views held. One is in favour of excessive fineness, *i.e.*, of the same order as in the case of basic slag, on the grounds that fineness makes for immediate action and renders small dressings possible; the other maintains that a medium fineness is all that is wanted, provided that somewhat heavier applications are made, the argument being that there will usually be enough really fine material in a gritty sample to supply immediate needs, the balance coming into action in course of time. There is something to be said for both standpoints. Against fine material there is no objection except that grinding costs mount rapidly as a greater degree of reduction is aimed at, and that in practice a floury material tends to hang together and is therefore less easy to distribute than a slightly gritty sample. In favour of coarse grinding is the relatively low cost and the fact that much of the material is considerably finer than the smallest sieve which will pass the whole. It is said that if ground limestone will pass through 10 meshes per linear inch about 70 per cent. of the whole will pass a 60-mesh sieve. Against this must be put the fact that material coarser than about 20 meshes is exceedingly slow to dissolve and must be reckoned almost as ballast to the finer and more active

material, thus increasing transport and handling costs. Where limestone is ground locally in small private plants* comparatively coarse stone, say through 10 meshes, will be quite satisfactory. In purchasing high-grade finely ground limestone from a distance, it is important to ascertain whether grinding costs and carriage have raised the price above that demanded for equivalent quick lime obtained locally.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending December 15				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	..	13 5	12 15	13 0	16 9
Sulphate of ammonia—					
Neutral (N. 20·6%)	11 18*	11 18*	11 18*	11 18*	11 7
Calcium cyanamide (N. 19%) ..	9 10*	9 10*	9 10*	9 10*	10 0
Kainit (Pot. 14%)	3 2	2 15	2 17	2 15	3 11
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	3 12	3 0	3 9	3 2	3 1
Muriate of potash (Pot. 50-53¼%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51½%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 30%)	..	3 2§	3 3§	3 6§	2 2
„ (T.P. 28%)	..	2 11§	2 19§	..	..
„ (T.P. 26%)	..	2 7§	2 15§	..	..
„ (T.P. 24%)	..	2 2§	..	2 11§	2 1
Ground rock phosphate (T.P. 58%)	2 10¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 11	..	3 9	3 10	2 0
„ (S.P. 33%) ..	..	..	3 6	..	..
„ (S.P. 30%) ..	3 5	2 12	3 2	3 3	2 1
Bone meal (N. 3¾%, T.P. 45%) ..	8 15	8 5	8 10	8 0	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 0†	6 10†	6 0	5 10	..
Burnt lump lime	2 0	1 12*a*	2 0*b*	2 1*c*	..
Ground lime	2 7	2 1*a*	2 9*b*	1 15*c*	..
Ground limestone	..	..	1 10*b*	..	..
Ground chalk	..	1 9	..	1 5*c*	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton. For the finer grade (80% through standard screen of 14,400 holes to the square inch) the price at London is 2s. 6d. per ton more than for the coarser grade.

a Delivered to Hull.
b Delivered to Liverpool area.
c Delivered in 4-ton lots to London.

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*For details see Bedell, B. H., this JOURNAL, February, 1919; June, 1921; and January, 1922.

MONTHLY NOTES ON FEEDING STUFFS

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The Feeding of Dairy Cows.—Through the efforts of Agricultural Organizers and milk-recording societies, the feeding of dairy cows has now been placed on a more established basis, and the old rule-of-thumb methods have given place to scientific systems of feeding. Messrs. Mackintosh, Garrad and Jesse have, in their respective counties, demonstrated to dairy farmers that, as far as food costs are concerned, milk production can be cheapened considerably by feeding according to scientific standards; and by their enthusiasm and unceasing efforts they have enabled dairy farmers to reap the fruits of the scientific labours in the laboratory of Kellner and other workers in this branch of animal nutrition. The merit of their work lies in the fact that they have translated scientific theory into agricultural practice, and this without upsetting the normal agricultural systems carried out on the individual farms.

It is unnecessary, perhaps, to point out that the type of farming carried out in various parts of the country differs considerably from district to district, and even from farm to farm; and that the system adopted in each case has been proved by years of long and, in some cases, painful experience to be the type best suited to that particular farm. As is well known, the type of farming carried out on any particular farm is determined by factors such as rainfall, elevation, type of soil, proximity to consuming centres, average summer and winter temperatures, etc., and even the type of stock kept varies according to these factors. These limitations are exemplified by the experience of new-comers to any district. A farmer coming from, say, the north of England to Kent may be dissatisfied with the prevailing conditions of farming he finds there, and may institute innovations by altering the systems of rotations, bringing in new breeds of live stock, and by changing cultivation methods. The innovations introduced are of value in that they persuade his neighbours to think of the possibility of changes for the better in their own established practices; but the final result is that the new-comer gradually alters, one by one, the innovations he has introduced, until finally his system conforms in nearly every respect with that adopted by his neighbours.

Whatever the system may be, it results in the production of a certain proportion of food suitable for human consumption, and a certain proportion that must be consumed by stock. Systems of feeding, therefore, to be successful must take into account the foods produced on the farm, and any system which involves neglect of this consideration cannot generally be successfully adopted.

Within recent years, a new system of rationing milch cows, which differs considerably from that followed successfully by Mackintosh, Garrad, Jesse and others, has been introduced, and is being adopted fairly widely by dairy farmers. Mr. Boutflour, while Agricultural Organizer for Wiltshire, discovered that the dairy cows of that county were being wrongly managed and wrongly fed. By intelligent application, with modifications, of the scientific systems already adopted in other counties and, above all, by introducing new methods of management, he was able to increase the milk yields of the herds he took under his control. As the result of this experience, he gradually evolved a new system for the feeding and management of dairy cows, and this system is being adopted by farmers wherever its advantages and benefits are properly expounded to them. The system has much to be said in its favour ; it lays stress on the necessity of the thorough and efficient management of the cow prior to, as well as during, the lactation period ; it recognizes the fact that there is a definite limit to the capacity of the cow to consume food in a given period ; and it points out that high milk yields can only be achieved by replacing coarse fodders by concentrated feeding stuffs. It also includes the rationing of cows on the scientific system established by Kellner and other research workers. It has, however, what, to the writer, appears to be one fatal disadvantage, *i.e.*, it ignores the normal system of farming carried on by the farmer, and, while it is of great value to the farmer who wishes to keep a herd of high-yielding milch cows, it is doubtful whether it will ever replace the system of feeding milch cows now in operation for the average dairy herd. From a national standpoint, too, it is deserving of consideration whether, in view of the difficulty in time of war of obtaining purchased feeding stuffs, it is wise to advocate a system of feeding which leads the farmer to rely chiefly on purchased foods for the production of a natural necessity—an adequate supply of milk. In the writer's opinion, the best system of milk production is that which depends, in the main, on the

Description	Price per qr. s. d.	lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British	—	—	12 0	0 15	11 5	72	3 2	1·70	9·6
Barley, British feeding ..	—	—	9 5	0 11	8 14	71	2 5	1·29	6·2
" Canadian No. 4 Western	33 9	400	9 8‖	0 11	8 17	71	2 6	1·34	6·2
" Persian	31 0	"	8 13	0 11	8 2	71	2 3	1·20	6·2
" Russian	35 0	"	9 17	0 11	9 6	71	2 7	1·38	6·2
Oats, English, white	—	—	9 13	0 13	9 0	60	3 0	1·61	7·6
" " black and grey	—	—	9 0	0 13	8 7	60	2 9	1·47	7·6
" Scotch white	—	—	10 7	0 13	9 14	60	3 3	1·74	7·6
" Irish black	—	—	8 15	0 13	8 2	60	2 8	1·43	7·6
" Canadian No. 2 Western	30 6	320	10 13*	0 13	10 0	60	3 4	1·78	7·6
" " feed	29 6	"	10 7‖	0 13	9 14	60	3 3	1·74	7·6
" American	22 9	"	8 0‖	0 13	7 7	60	2 5	1·29	7·6
" Argentine	24 9	"	8 13	0 13	8 0	60	2 8	1·43	7·6
" Chilian	25 3	"	8 17	0 13	8 4	60	2 9	1·47	7·6
Maize, Argentine	34 9	480	8 2	0 12	7 10	81	1 10	0·98	6·8
Beans, English winter	—	—	10 5	1 10	8 15	66	2 8	1·43	20
Peas, " blue	—	—	17 0*	1 6	15 14	69	4 7	2·45	18
" Japanese	—	—	30 0†	1 6	28 14	69	8 4	4·46	18
Dari, Bombay	—	—	12 5	0 14	11 11	74	3 1	1·65	7·2
Rye, homegrown	—	—	9 5	0 15	8 10	72	2 4	1·25	9·1
Millers' offals—									
Bran, British	—	—	7 5	1 5	6 0	42	2 10	1·52	10
" broad	—	—	8 10	1 5	7 5	42	3 5	1·83	10
Middlings, fine, imported ..	—	—	9 15	1 1	8 14	69	2 6	1·34	12
" coarse, British ..	—	—	7 17	1 1	6 16	58	2 4	1·25	11
Pollards, imported	—	—	6 15	1 5	5 10	60	1 10	0·98	11
Meal, barley	—	—	10 15	0 11	10 4	71	2 10	1·52	6·2
" maize	—	—	9 17	0 12	9 5	81	2 4	1·25	6·8
" " germ	—	—	9 15	0 18	8 17	85	2 1	1·12	10
" " gluten feed ..	—	—	8 15	1 5	7 10	76	2 0	1·07	19
" locust bean ..	—	—	9 5	0 9	8 16	71	2 5	1·29	3·6
" bean	—	—	12 10	1 10	11 0	66	3 4	1·78	20
" fish	—	—	22 0	4 0	18 0	53	6 10	3·66	48
Maize, cooked flaked	—	—	10 15	0 12	10 3	85	2 5	1·29	8·6
Linseed									25
" cake, English, 12% oil	—	—	12 15	1 16	10 19	74	3 0	1·61	25
" " " 10% "	—	—	12 5	1 16	10 9	74	2 10	1·52	25
" " " 9% "	—	—	11 17	1 16	10 1	74	2 9	1·47	25
Soya bean " 6% "	—	—	12 5*	2 10	9 15	69	2 10	1·52	36
Cottonseed cake, English, 5½%, "	—	—	7 2	1 13	5 9	42	2 7	1·38	17
" " Egyptian, 5½% "	—	—	6 7	1 13	4 14	42	2 3	1·20	17
Decorticated cottonseed meal, 7% oil	—	—	9 7	2 10	6 17	74	1 10	0·98	35
Coconut cake, 6% oil	—	—	9 0	1 9	7 11	79	1 11	1·03	16
Ground nut cake, 6% oil ..	—	—	7 10	1 14	5 16	57	2 0	1·07	27
Decorticated ground nut cake, 7% oil	—	—	11 15*	2 12	9 3	73	2 6	1·34	41
Palm kernel cake, 6% oil ..	—	—	9 0*	1 1	7 19	75	2 1	1·12	17
" " " meal, 6% oil	—	—	9 10*	1 1	8 9	75	2 3	1·20	17
" " meal, 2% oil ..	—	—	6 15*	1 2	5 13	71	1 7	0·85	17
Feeding treacle	—	—	6 0	0 9	5 11	51	2 2	1·16	2·7
Brewers' grains, Dried ale ..	—	—	7 15	1 2	6 13	49	2 9	1·47	13
" " " porter ..	—	—	7 5	1 2	6 3	49	2 6	1·34	13
" " Wet ale ..	—	—	1 4	0 8	0 16	15	1 1	0·58	4·8
" " " porter ..	—	—	0 19	0 8	0 11	15	0 9	0·40	4·8
Malt culms	—	—	7 0†	1 12	5 8	43	2 6	1·34	16

* At Hull. † At Liverpool. ‖ At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of November and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivale t in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 12s. 0d. P_2O_5, 3s. 8d.; K_2O, 2s. 11d.

economic utilization of home-produced foods, with the utilization of purchased foods only in so far as they cheapen that production.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows :—

	Starch equivalent	Protein equivalent	Per ton
	Per cent.	Per cent.	£ s.
Barley	71	6·2	9 10
Maize	81	6·8	8 3
Decorticated ground nut cake	73	41·0	11 15
" cotton cake	71	34·0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2·28 shillings, and per unit protein equivalent, 1·69 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connection with advisory schemes on the rationing of dairy cows, are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	9 0
Oats	60	7·6	7 10
Barley	71	6·2	8 12
Potatoes	18	0·6	2 2
Swedes	7	0·7	0 17
Mangolds	7	0·4	0 17
Beans	66	20·0	9 4
Good meadow hay	31	4·6	3 18
Good oat straw	17	0·9	2 0
Good clover hay	32	7·0	4 5
Vetch and oat silage	13	1·6	1 12
Barley straw	19	0·7	2 4
Wheat straw	11	0·1	1 5
Bean straw	19	1·7	2 6

MISCELLANEOUS NOTES

The Agricultural Index Number

THE general level of the prices of agricultural produce during November was the same as in October, being 48 per cent. above the base years 1911-13. The prices of the great majority of commodities declined on the month, but increases in the case of wheat, oats, potatoes, eggs and milk were sufficient to counterbalance the general tendency to decline.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921 :—

Month	Percentage increase compared with the average of the corresponding month in 1911-13					
	1921	1922	1923	1924	1925	1926
January	180	71	67	60	71	58
February	164	75	63	61	69	53
March	146	73	59	57	66	49
April	145	66	54	53	59	52
May	115	69	54	57	57	50
June	105	64	49	56	53	48
July	103	67	50	53	49	48
August.	122	68	52	57	54	49
September	113	59	52	61	55	55
October	82	61	50	66	53	48
November	74	63	51	66	54	48
December	71	61	55	65	54	—

Live Stock

With the exception of store sheep, all classes of live stock were slightly cheaper than a month earlier. Fat cattle at an average of 44s. per live cwt. show a reduction of 1s. 6d., and the index figure is 4 points lower at only 31 per cent. above pre-war. Fat sheep were very slightly cheaper at 10¾d. per lb. estimated dressed carcass weight, and as there was a slight advance in price in the base years the index figure shows the considerable drop of 9 points to 43 per cent. above 1911-13 as compared with 63 per cent. a year previously. Bacon pigs and porkers show decreases of 6d. and 3d. per 14 lb. stone (estimated dressed carcass weight) respectively and the relative index figures are lower at 71 and 76 per cent. above 1911-13. Porkers sold at practically the same prices as in November last year, but baconers were 6d. per stone cheaper on the year. During November the prices of dairy cattle fell away somewhat from the October average and showed a decline of about 10s. per head, and the index figure moved downwards 4 points to 34 per cent. above the base years, or 8 points less

than in November, 1925. Store cattle were also cheaper than during last month and the index number declined to 22 per cent. above pre-war as compared with 32 per cent. a year earlier. An appreciation of 2s. per head in the price of store sheep in November is not reflected in the index figure on account of the fact that a relatively larger increase occurred in the corresponding period of the base years and the index figure is 5 points lower at 42 per cent. above the level of 1911-13. Store sheep were much cheaper than a year ago when the increase over pre-war was 68 per cent. The reduction in the price of store pigs caused the index figure to fall 7 points, but at the November figure of 135 per cent. above pre-war, store pigs remain very dear.

Grain

Wheat further appreciated in price during November, and at an average of 12s. 5d. per cwt. was 1s. 1d. dearer on the month, while the index figure advanced 13 points to a level of 66 per cent. above 1911-13 as compared with 49 per cent. a year ago and 68 per cent. in November, 1924. Barley was 7d. per cwt. cheaper than in October, and the index number registered a decline of 7 points to 35 per cent. above pre-war, which was the figure shown a year previously. A rise of 4d. in the price of oats to 8s. 5d. per cwt. advanced the index 3 points, but at 20 per cent. above the base period, oats were 10 points lower than in November, 1925.

Dairy and Poultry Produce

The estimated average price of milk delivered under contract in the Manchester area was higher in November, and as a result the index number rose by 4 points to 64 per cent. above pre-war, which compares with 74 per cent. in November, 1925. Average prices of butter and cheese were unchanged on the month, but as in both cases there was an increase in the base period, the relative index numbers are lower at 47 and 28 per cent. above pre-war. Eggs advanced sharply to 2s. 10d. a dozen, but as this increase is not relatively so sharp as in the years 1911-13, the index figure shows a fall from 68 per cent. to 60 per cent. above those years, whereas a year previously eggs were 80 per cent. above the pre-war price.

Other Commodities

The sharp movement in potato prices which was noticeable in October continued during the early part of November, but towards the latter part of the month prices were comparatively

steady. The average wholesale price rose on the month by about £1 per ton to about £7 10s. per ton with a consequent rise in the index figure of 32 points to 113 per cent. above pre-war. A year ago potatoes were about 25 per cent. cheaper than this year. Hay was a little cheaper in November and the index figure was 2 points lower, bringing hay to only 4 per cent. above pre-war. Fruit during November was scarce and dear, and vegetables showed a dearer tendency at an increase of 13 points above the previous month's figure, although Brussels sprouts and carrots were cheaper than in October.

Index numbers of different commodities during recent months and in November, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	Nov.	Nov.	Aug.	Sept.	Oct.	Nov.
Wheat	68	49	69	50	53	66
Barley	89	35	52	50	42	35
Oats	45	30	33	25	17	20
Fat cattle	47	48	43	39	35	31
Fat sheep	90	63	52	52	52	43
Bacon pigs	46	79	79	79	74	71
Pork pigs	46	75	83	81	81	76
Dairy cows	60	42	37	39	38	34
Store cattle	36	32	33	28	25	22
Store sheep	94	68	63	63	47	42
Store pigs	33	97	139	142	142	135
Eggs	84	80	49	52	68	60
Poultry	62	49	55	46	48	49
Milk	82	74	60	100	60	64
Butter	74	71	56	56	52	47
Cheese	38	75	43	34	30	28
Potatoes	168	60	11	40	81	113
Hay	1	3	11	9	6	4
Wool	113	52	24	31	32	31

Correspondence Courses in Agriculture

A CIRCULAR letter was issued by the Ministry in the autumn of 1925 to County Education Authorities, enclosing a memorandum giving an account of the Correspondence Classes in Agriculture held as an experiment during the previous winter session in five counties in England and Wales, and suggesting that other County Authorities might consider participation in the scheme.

During the winter session 1925-26 a second course was held in Derby, Lincoln (Lindsey), and East Suffolk, and the experiment was tried for the first time in Lincoln (Kesteven) and Surrey. In Salop and in Pembroke, classes were offered, but were abandoned owing to lack of sufficient entries. In East Sussex and in Anglesey, where courses were given in 1924-25, no further classes were offered, as the county staff were unable to cope with the work involved owing to an increased demand for organized classes.

The classes held were on the whole very successful, and a large proportion of the students completed the courses. The organizers testify to the value of the instruction and to the high standard of the work done. There was no complaint in 1925-26, as was the case in 1924-25, of the lack of general education shown by the students, but, in cases where the classes extended well into the spring, it was again found that the increasing pressure of work on the farms prevented students from completing the course.

In Derby the course, which lasted from October to May, consisted of twelve lessons in Plant Hygiene, Animal Husbandry, and Veterinary Science, and the textbooks used were Russell's *Students' Book on Soils and Fertilizers*, Porter's *Stockfeeder's Companion*, and Thompson's *Elementary Veterinary Lectures*. The students paid a fee of 10s. and purchased their own books. Fifteen students enrolled, seven having weekly lessons and eight fortnightly. Only two completed the course, which ended in May; others reached various stages, and many found increasing pressure of work in the spring occupied their time too fully to allow of study. It was hoped that most of the students would resume their studies in the autumn.

In Kesteven the class began in December and ended in March, and twelve pupils enrolled for the course of four lessons based on Somerville's *Agriculture*. No fees were paid, but the students bought their own textbooks. Marks were given for the answers to the test papers done, and the first three pupils were awarded standard works on agriculture as prizes.

Two courses were arranged for Lindsey, one for last year's students and one for new pupils. Nine out of fourteen enrolled for the continuation course. The subject of study was "Animal Nutrition," and the textbook used, Porter's *Stockfeeder's Companion*. The course for new pupils was similar to that held last year. Thirteen students joined, and nine completed

the course. The textbook used was Somerville's *Agriculture*. Each course consisted of ten lessons, fortnightly papers were set, and the three top students in each class were presented with the copy of the textbook which had been lent by the County Authority. No fees were charged. The results were generally satisfactory.

Seven pupils joined the class in East Suffolk and worked regularly throughout the course. No fees were paid by the students, but each purchased the textbook, Somerville's *Agriculture*. The course was advertised through the schools, but the response was rather disappointing. The Suffolk Branch of the National Farmers' Union have offered three prizes, as they did last year, for the best students. The Agricultural Organizer states that the value of the course as a means of teaching agricultural science is undoubted. The work done by the students was in some cases of a very high standard.

The Surrey course was described as a "reading course," but hardly differed from those held in the other counties. It was started in February and continued till late spring; no fees were charged. The textbook, Mackintosh's *Feeding of Dairy Cows*, was purchased by the students. Full instructions for reading were sent with the textbook, and a set of questions was sent ten days later. The book was divided for reading purposes into four sections, and a paper of questions was set on each. Sixteen students entered, but the numbers decreased as the season progressed, owing to the pressure of farm work. A high standard of excellence was reached, more particularly by those who completed the course. To be really successful it appears that the course should commence in October or November and end in February or early March.

Germination of Seed Peas

THE Regulations made under the Seeds Act, 1920, require, in the case of a sale of seed peas, that the seller shall deliver to the purchaser a statement in writing containing certain specified particulars including (1) the name and address of the seller; (2) a statement that the seeds have been tested in accordance with the provisions of the Act; (3) the kind of seed; (4) the percentage of purity if below 97 per cent.; and (5) the percentage of germination; provided that, if the percentage of germination is not less than the authorized minimum percentage of germination prescribed

in the Schedule to the Regulations (*viz.*, 70 per cent.), a statement to that effect, which shall include the authorized minimum percentage of germination, shall be sufficient. As was the case last year, there are indications that the germination of the 1926 crop of seed peas is below normal, and that consequently a considerable proportion of the peas marketed this season will be found to germinate slightly less than the minimum percentage prescribed in the Seeds Regulations. The sale of seed peas with a germination of less than 70 per cent. is not contrary to the Regulations, provided the actual percentage of germination is declared. To avoid failures in the crop, it is advisable that seeds testing less than 70 per cent. should be sown rather more thickly than usual.

Leaf Spot of Celery

ARRANGEMENTS have been made for the Official Seed Testing Station, Cambridge, to undertake the examination of samples of celery seed for the presence of the fungus (*Septoria apii* Chester) which causes the disease known as "Leaf Spot," or "Blight." This is a seed-borne disease which has been greatly on the increase during recent years. Samples submitted for this purpose should contain not less than 100 seeds, and should be addressed to the Chief Officer, Official Seed Testing Station, Huntingdon Road, Cambridge, together with a fee of 2s. for each sample sent.

"Leaf Spot" is frequently overlooked until the plants are reaching maturity, but the early stages of infection are to be found in the seedling stage. The ultimate damage done is often so extensive that serious financial loss results. The disease is characterized by the presence on the foliage of discoloured areas on which the minute black fruiting bodies of the fungus are just visible to the naked eye. The spots increase in size and number until the whole leaf becomes a dirty greenish-brown colour, and finally rots and withers away. Although the disease may, perhaps, be communicated to a fresh crop by infected material from a previous diseased crop, the more common source of infection lies in the seed.

In dealing with methods of control, Leaflet 238, which gives a full account of the disease and can be obtained from the Ministry, suggests, *inter alia*, that in purchasing celery seed the buyer should ask for a guarantee in writing that

the seed has been examined by a competent expert, and has been found free from the fungus. It is in order to enable such a guarantee to be given in cases where it is warranted or to be checked, if deemed necessary, that the arrangements mentioned above have been made for the examination of seed samples at the Official Seed Testing Station.

Refresher Course for Horticultural Instructors

A REFRESHER course for Horticultural Organizers and Instructors was held at Leeds University during the last summer vacation. The object of the course was to enable horticultural teachers to maintain touch with new scientific work, more particularly in Botany and Soil Chemistry, and, in this way, to assist them with regard to organized classes, which are becoming a great feature of county instruction. The course extended from July 5 to July 10, and the University co-operated in the scheme by placing its staff at the disposal of the Ministry and by providing, free of charge, classroom and laboratory accommodation. Four subjects were dealt with during the week, viz.: Botany by Professor Priestley; Mycology by Mr. W. A. Millard; Zoology by Mr. T. H. Taylor; and Soil Physics and Chemistry by Professor Comber.

Farm Workers' Minimum Wages.—A meeting of the Agricultural Wages Board was held on December 6 at 7 Whitehall Place, London, S.W.1, the Chairman, Lord Kenyon, presiding, when notification was received from the Cornwall and Isles of Scilly Agricultural Wages Committee that they had fixed minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to come into operation on December 16, 1926 (*i.e.*, the day following that on which the existing rates are due to expire), and to continue in force until further notice. The Board made an Order carrying out the decision accordingly.

The minimum rates are in the case of male workers of 21 years of age and over 31s. per week of 51 hours, with overtime at 9d. per hour on weekdays and 10d. per hour on Sundays, and in the case of female workers of 21 years of age and over 5d. per hour for all time worked. Lesser rates are fixed for younger male and female workers. The rates are in all cases the same as those already in force in the area.

A copy of the order in full may be obtained on application to the Secretary of the Agricultural Wages Board.

Enforcement of Minimum Rates of Wages.—During the two months ending December 15, legal proceedings were instituted against 12 employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture. Particulars of the cases are as follows —

County	Court	Fines £ s. d.	Costs £ s. d.	Arrears of wages ordered to be paid £ s d	No. of workers concerned
Soke of Peterboro'	Peterboro'	—	3 3 0	10 0 0	3
Lancashire .	Bolton ..	5 0 0	—	8 13 4	1
Holland ..	Holbeach	3 0 0	1 10 0	15 7 0	3
Glamorgan .	Bridgend.	2 0 0	0 14 6	6 1 5	
Montgomery	Welshpool	3 3 0	0 5 0	18 0 0	
Wilts ..	Devizes .	0 1 0	–	11 0 0	
Hants ..	Romsey .	4 0 0	—	16 8 6	
Devon ..	Exeter ..	10 0 0	10 10 0	42 18 4	
Oxford ..	Chipping Norton	1 0 0	—	26 19 6	
Lancs ..	Bolton ..	– –	—	1 0 0	
Devon ..	Axminster	1 0 0	1 5 0	22 14 3	3
Cornwall ..	Launceston	1 0 0	—	7 0 0	1

Proceedings were also instituted against an employer at Kington (Hereford), under Section 9 (3) (*b*) (Refusal to give information) of the Agricultural Wages (Regulation) Act, 1924. The defendant was fined £5.

A charge of furnishing false information was also taken into account in the proceedings at Bolton.

In the case heard at Holbeach the Ministry had secured the payment of certain arrears of wages due in respect of Saturday afternoon overtime. The Ministry, however, considered that further arrears of wages were due in consequence of alleged illegal deductions from wages in respect of the provision of cottages. The workers concerned had signed contracts of service which provided that the workers were entitled to be paid at the minimum rates of wages laid down in the Orders of the Agricultural Wages Board, and that they should refund to the employer 6s. per week in respect of the occupation of their cottages. The employer alleged that no deduction from wages was made, but that the workers received their full cash wages and paid back to the employer's wife 6s. per week in respect of the cottages. This statement was corroborated by the employer's wife and son. The workers denied that they received their full cash wages, and asserted that the 6s. was deducted.

The Ministry prosecuted the employer for paying the workers 3s. per week less than the minimum rates applicable to them, the under-payment being in fact the difference between 6s. and the 3s. defined by the Committee as the value of the provision of a cottage. The Ministry's Counsel argued that even if the workers received their full cash wages and paid back 6s. to the employer's wife, there would still have been a contravention of the Act, since the occupation of the cottages in question was part of the workers' contracts of service. The Bench found as a fact that the 6s. per week was deducted from the workers' wages, and fined the employer £3, awarding £1 10s. 0d. costs and arrears of wages amounting to £15 7s. 0d.

Appeal Case.—On October 13 there was heard at the High Court, before the Lord Chief Justice, Mr. Justice Avory, and Mr. Justice

Salter, the first appeal under the Agricultural Wages (Regulation) Act, 1924.

In a case heard on September 29, 1925, at the Raglan Police Court, a farmer was prosecuted for paying a worker less than the minimum rate of wages applicable to him. The worker was supplied with board and lodging, but the Monmouthshire Agricultural Wages Committee, having made an Order prohibiting the reckoning of any benefits or advantages as part payment of the minimum rates of wages fixed by the Agricultural Wages Board, the Ministry was of opinion that no deduction could be made from the worker's wages. The Bench, however, held, as a question of law, that the Committee's Order as to benefits or advantages had no effect, and that there was nothing to prevent an employer and worker from making an agreement as to what sum should be reckoned as the value of board and lodging, and deducting such amount from the weekly wages paid to the worker. Despite this decision it was found that, after making reasonable allowance for board and lodging, the worker still received 3s. 7d. per week less than the minimum rates of wages applicable to him. The Bench fined the employer the nominal sum of 2s. 6d., and ordered payment of the arrears of wages due to the worker only for the particular week in respect of which the summons was issued, and refused to order the payment of arrears for previous weeks, despite the fact that, under-payment having been proved, the Bench was bound under Section 7 (3) of the Act to order the payment of arrears of wages found due to the worker during the period of six months immediately preceding the date on which the information was laid.

The High Court upheld the Ministry's appeal, and the following is an extract from the statement made by the Lord Chief Justice:—

> It is apparent, therefore, that in the present case, as from July 4, 1925 (the date on which the Committee's prohibitory Order was made), there was an improper deduction of the sum of 17s. per week, and by sub-section (3) of section 7 of the Statute there is an imperative duty laid down: "In any proceedings against an employer under this section the Court shall"—not "may," but "shall"—"whether there is a conviction or not, order the employer to pay in addition to the fine, if any, such sum as may be found by the Court to represent the difference between the amount which ought at the minimum rate applicable to have been paid to the worker during the period of six months immediately preceding the date on which the information was laid or the complaint was served and the amount actually paid to him during that period." It is now, in the course which the argument has taken, common ground that as from July 4, 1925, the sum of 17s. was improperly deducted.

The High Court thereupon remitted the case to the Raglan magistrates for re-hearing.

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False Description of Seed Potatoes.—Proceedings for making false statements in connexion with the sale of seed potatoes have been taken by the Ministry of Agriculture in two cases recently. In the one case, a dealer of Bromyard sold a quantity of seed potatoes which he described as being grown in Scotland, whereas it was proved that they came from Cambridgeshire. He also quoted a false certificate number. His defence was that the English-grown seed was sent in mistake, his man loading it out of a truck at the railway station instead of from his own yard. The Bench imposed a fine of £3 for the offence under the Wart Disease of Potatoes Order, and £2 under the Seeds Act, and ordered payment of special costs which amounted to £14 11s. 0d.

In the other case, a firm of potato merchants of Cambridge was summoned in respect of the sale of some seed potatoes of mixed varieties with which they had given a statement indicating that the variety was true within the meaning of the Seeds Regulations, 1922. The defendant acknowledged that he had bought this seed as being mixed and took the risk of re-selling it as pure. He was fined the maximum penalty of £5 and £3 3s. 0d. special costs.

It is necessary under the Seeds Act, 1920, in the case of a sale of seed potatoes, for the seller to make a statement in writing containing particulars as to the class, variety, and size and dressing of the seed sold. It is also necessary in connexion with the Wart Disease of Potatoes Order to state the number of the relative "clean land" or "true stock" certificate referring to the potatoes in question issued under that Order.

Sugar Beet Cultivation in Holland.—Some interesting particulars concerning sugar beet cultivation in Holland are given in a *Report* on the Economic, Financial and Industrial Conditions of the Netherlands.* Following the distribution of a questionnaire in the northern counties of Holland, replies were received from 26 growers in Groningen, 27 in Friesland, and 3 in other districts.

The question whether the soil should, periodically, be allowed to lie fallow was unanimously answered in the negative. The answer to the question regarding the influence of sugar beet cultivation on the soil was that, provided the ground is kept well weeded, the influence is very good. The questions whether growers intend to continue growing sugar beet, and whether it is a good alternative crop, were answered in the affirmative. The answer to the question whether the beet tops were equivalent in value to the wages paid was not unanimous: 18 replies estimated the value as higher, 25 as lower, and the remainder stated that it depended on local circumstances.

The cost of raising a *wheat* crop (including seed, fertilizer, preparing the soil, weeding, sowing, transporting, threshing, pressing) amounted to £8 11s. 6d. per acre in Friesland and to £9 7s. 1d. per acre in Groningen, the difference being due to the greater cost of fertilizers in the latter county; the production of wheat averaging 27·13 cwt. per acre in Friesland and 28·75 cwt. per acre in Groningen.

The cost of raising a *sugar beet* crop (fertilizers, preparing the soil, weeding, collecting, lifting, transporting, siloing, etc.) in Friesland amounted to £12 19s. 3d. per acre against £13 0s. 8d. per acre in Groningen. Again, there was a considerable difference in the cost of fertilizers in Friesland and Groningen, being £2 3s. 4d. per acre and £2 17s. 4d. per acre respectively. The average production of sugar beet in Friesland was 12·71 tons per acre, and in Groningen 13·15 tons per acre. Groningen concentrates more on the production of seed grain, and the straw prices there are better owing to the proximity of strawboard works. Apparently the increased use of fertilizers has great influence on the formation of tops, the value of which is estimated at £5 17s. 0d. per acre, and that of straw at £4 10s. 3d. per acre.

In calculating costs, the work of one horse per hour was fixed at 10d., the hourly wage of a labourer at 6d., and the distance from the farm to the quay or station at one kilometre (approximately two-thirds of a mile).

The conclusion reached is that, notwithstanding the higher cost of

* By the Department of Overseas Trade, February, 1926. Obtainable from His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2. Price 3s. net.

production, the value of the product, provided the sugar market remains at the present level, will warrant the continuation of sugar beet growing. The sources of information from which the above has been taken reveal the fact that the greatest amount of labour in sugar beet growing is required at a time when other crops do not call for much attention, and it forms a link, therefore, in keeping labour employed during the whole year. It is stated that every farmer can put up to 15 per cent. of his arable land under sugar beet, needing, with the exception of weeding, only his normal staff for its attention.

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Leaflets issued by the Ministry.—Since the date of the list given in the October (1926) issue of the JOURNAL, p. 683, the following leaflets have been issued :—

New :—

No. 149. Bacillary White Diarrhœa of Chicks.
No. 163. C.O.D. and the Farmer.

Rewritten :—

No. 8. Assessments to Local Rates.
No. 369. Backyard Poultry Keeping.
No. 238. Leaf Spot of Celery.

Revised :—

No. 10. Wireworms.
No. 46. The Stem Eelworm.
No. 83. Home Preservation of Eggs.
No. 302. Silver Leaf in Fruit Trees.
No. 382. Liquid Manure Tanks.
No. 48. Pea and Bean Thrips.
No. 400. List of Publications issued by the Ministry.

Amended :—

No. 112. Weeds and Their Suppression.
No. 143. Destructive Insects and Pests Acts, 1877-1907.
No. 187. The Selection and Milking of Dairy Cattle.

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Injurious Weeds.—Proceedings may be taken by or on behalf of the Minister against any occupier of land failing to comply with a notice served upon him under the provisions of the Corn Production Acts (Repeal) Act, 1921, requiring him to cut down or destroy any spear thistle, creeping thistle, curled dock, broad-leaved dock, or ragwort growing on his land. During the past two months proceedings have been instituted on behalf of the Minister by the County Agricultural Committees of East Sussex, Bucks (two cases), Leicester (three cases), and Lancashire. A conviction was obtained in each case, and fines of £20, £5, £15, £5, £1 1s. 0d., 10s., and £5 respectively were imposed, each defendant having to pay costs in addition.

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Foot-and-Mouth Disease.—Five outbreaks of foot-and-mouth disease have been confirmed since the issue of the December number of the JOURNAL. A new centre of disease was discovered at Ramsbury, Wiltshire, on November 25, and a further outbreak occurred in that district at Ashmansworth (Hampshire) on December 6. Fresh centres were also found at Weekley, near Kettering, Northants, on November 29, at Chester on November 29, at Burgess Hill, East Sussex, on December 17, and at Kiver, near Dover, on December 19. A further outbreak occurred in the Burgess Hill area on December 21.

The above outbreaks bring the total for the year to 203, involving 31 counties, and the slaughter of 5,743 cattle, 11,671 sheep, 2,503 pigs, and 9 goats.

NOTICES OF BOOKS

Agricultural Surveying. By John Malcolm, B.Sc., N.D.A. (Hons.). (London: University Tutorial Press, Ltd. Price 5s. 6d.)

This is an elementary text-book on survey and farm engineering for the use of agricultural students, and as such has much to recommend it. The arrangement of the chapters is good, the descriptions are clear and concise, and a great deal of useful and practical information is given on all subjects connected with farm and estate management. The contents of the book may be roughly divided under three heads. Mensuration has two chapters devoted to it, dealing with simple methods of calculating areas and solids. Surveying takes up six chapters and covers a fairly wide field. Descriptions of a number of instruments, including the theodolite and level, are given, and their practical use is explained. A few pages are given to the description and use of Ordnance Survey maps and their practical value to the agriculturist. The final section forms a short treatise on estate engineering, draining, and road-making. Included in the book are selections of questions and answers from examination papers, and some four-figure mathematical tables. It is essentially a work for students, as the preface states, but would be useful to anyone who is occasionally faced with simple survey problems connected with farm and estate management.

Aims and Methods in the Study of Vegetation. Edited by A. G. Tansley, M.A., F.R.S., and T. F. Chipp, M.C., B.Sc., Ph.D. (London: Published by the British Empire Vegetation Committee and the Crown Agents for the Colonies, 4 Millbank, S.W. Price, in the Empire, 12s. 6d., in the U.S.A., 4 dollars.)

This book is an outcome of the Imperial Botanic Conference of 1924, and is intended to set out the methods which should be followed in order to make a systematic survey of the vegetation carried by a given area. It applies chiefly to the less settled countries carrying to a large extent their natural vegetation, more or less modified by partial clearing or cultivation, by grazing or fire and the other incidents due to the presence of man. Thus it appeals mainly to forest and agricultural officers who have to consider the uses to which such land can be turned, but any botanist, professional or amateur, may peruse it with profit as it will extend his appreciation of study in the field. Indeed, of late years botany has been too much divorced from field observation; men got tired of systematic work, of mere collection and determination of species, but botany is only becoming real again as the botanist begins to interest himself in observations of the associations of species with one another, the environment of soil, situation and local climate, and the reasons which determine the presence of particular types in localized areas. Ecology is in fact almost a new science—even the name is hardly recognized by the general reader—and this book is an instruction in ecological study on an empire scale. Like all new sciences ecology has invented a new terminology, and the reader of the earlier chapters of this book must steel himself not to be put off by the liberality with which it is sprinkled with novelties in nomenclature. This specialization on labelling has always been a weakness of the botanist; it makes for precision, and, however repellent to the outsider, it gives the man who knows a satisfactory feeling of belonging to the elect.

But though the book is primarily addressed to the student of the wilder regions of the world there is still plenty of scope for the study of ecology in England and Wales, and it is not without its bearing upon agriculture. The weeds of the arable and the flora of the hedgerows are among the surest indications of the character and capabilities of

agricultural land, while the improvement of grassland, both the direction and the extent the expenditure should take, must be judged from the flora naturally established on the surface.

The earlier chapters of the book are concerned with the aims and methods of the study of vegetation, and include three generally valuable chapters on the habitat and the factors that are operative—temperature, rainfall, humidity, exposure, soil composition, and the effect of living organisms, including man. The later chapters supply examples of the methods as applied to particular areas, ranging from the forest lands of West Africa, India, and Canada, to the grazing land of New Zealand, South Africa, and the districts of Australia. The book should be in the libraries of all Agricultural Colleges, where some of their students may be expected to go overseas.

Potash: A Review, Estimate, and Forecast. By J. W. Turrentine, Ph.D. (London: Chapman & Hall. 1926. 188 pp. Price 15s. net.)

This book is written from the American standpoint, and gives a comprehensive view of the potash position in the United States with special reference to the case for increased home production. The author, who writes with full inside knowledge of the steps taken by the United States Department of Agriculture to handle the wartime potash situation, urges that a home potash industry should be developed in order to remove the risk of exploitation at the hands of foreign interests, and to provide a nucleus capable of rapid expansion to meet full requirements in case of need. He points out that such an industry must be able to stand on its own feet in face of competition from imports amounting to about 200,000 tons of pure potash annually, and therefore regards it as essential that costs should be lowered by producing potash either as a by-product or in conjunction with by-products.

The first section of the book deals briefly and clearly with potash production outside the United States. A view of the German and French industries is given and reference is made to the lesser known producing countries, Poland, Italy, Spain, and Japan. An increase in the production of potassium nitrate as a by-product from the manufacture of Chile nitrate is shown to be probable.

The potash industry in the United States is next dealt with. In 1910 a survey of the natural resources of raw materials for potash manufacture had been undertaken for the Government, so the outbreak of war did not find the country entirely unprepared. As a result of this and other work, salts containing nearly 50,000 tons of pure potash were produced in 1918, although the producers scarcely had time to master their technical problems and the majority had to close down when imported potash again appeared on the market. The account of those processes which have been maintained in spite of the prevailing low prices is of special interest. The author describes and examines actual and prospective methods for the extraction of potash from Kelp, Brines, and Silicates, and then passes on to discuss the more immediate problem of potash recovery from wastes derived from sugar factories, cement works, and blast furnaces. The quantities of potash available from each of these sources is estimated, and it is shown that the recovery of the potash from the industrial wastes alone would go a long way towards meeting home demand for potash salts, and that the solution of the technical problems involved is in sight.

Like most accounts of the utilization of wastes and residues, or the elaboration of raw materials formerly regarded as worthless, this

book makes interesting reading. It should provide agricultural teachers and students with many new ideas, and can be recommended to those interested in the technical side of the fertilizer industry.

The Dying Peasant. By J. W. Robertson Scott. (London: Williams and Norgate. Price 10s. 6d. net.)

This book describes in picturesque language some of the troubles from which agriculture is suffering. The author is particularly concerned and sympathetic with the position of the agricultural labourer; rightly, he lays great emphasis on the standard of living of the worker as an essential part of the agricultural problem. But he is content neither to inquire very deeply into the causes of the changes that have passed and are passing over British agriculture, nor to offer much in the way of constructive proposals, and for this reason the value of what he has to say is necessarily limited. A good deal of the book is made up of statements, comments and anecdotes quoted not only from recognized agricultural authorities, but from others whose authority to speak on these subjects may not be so well established. Moreover, many of these statements obviously apply to particular circumstances, and throw very little light on the problem as a whole.

Nevertheless, the book contains some useful information on the subject of agricultural wages and the cost of living; and the vivid pictures of village life, both in the north and the south, serve to focus attention of that aspect of the agricultural problem which it is always desirable to keep before us, namely, the national importance of healthy and happy rural life.

Farm Calculations and Accounts. By A. G. Ruston, D.Sc., B.A., and C. Vivian Dawe, B.Com. (London University Tutorial Press, Ltd. Price 3s. 6d. net.)

This little treatise of 216 pages is rather overweighted by its title, and an even more ambitious sub-title could be omitted with advantage. Authors of text-books probably have grounds for discounting the standard of intelligence in possible readers, but the first two or three chapters of this book, embodying rules and exercises in elementary arithmetic, would seem to be of questionable value. The space so occupied might well be devoted to an expansion of the information given in the later chapters, particularly that dealing with soils, manures, crops, foodstuffs, live stock, and dairying, all of which is very helpful, but merited more extended treatment. The notes on rates and taxes in Chapter V are too restricted to be of much value to the farmer, and the inclusion of inhabited house duty is a slip, this duty having been repealed two years ago (Finance Act, 1924, Chap. II, s. 20). The book, however, contains much valuable information in a concise and lucid form, and should prove a useful addition to the farmer's and farm student's bookshelf.

Dairy Cattle. By W. W. Yapp, Ph.D., and W. B. Nevens, Ph.D. (London: Chapman & Hall, Ltd., 1926; price 11s.)

While it is doubtful whether this book supplies an urgent need in this country, yet the excellent and methodical treatment of the subject matter marks it out as a useful textbook for students and a practical reference book for dairy farmers.

Great importance is attached to the systematic selection and breeding of dairy cows, and the chapters on the rearing of calves and heifers are excellent.

The section dealing with the feeding and management of the dairy herd is comprehensive, but due allowance must be made for the climatic conditions and general system of cropping prevalent in the authors' country.

The importance of correct recording and marketing is made evident. The book is well illustrated throughout, and constitutes an up-to-date groundwork of information suitable for a wide circle of readers.

Marketing of Agricultural Products. By James E. Boyle, Ph.D. (McGraw-Hill Publishing Co., Ltd. 479 pp. + viii. Price 17s. 6d.)

A recognition of the fact that agriculture differs only in degree and not in essence from other industries, and that, from being mainly concerned in the extraction of a few vital foodstuffs from the "bounteous or niggardly hand of Nature," it has come to represent a group of highly commercialized industries producing for distant markets, has led the writer of this book to adopt a novel mode of exposition. Starting from the standpoint of consumer-demand as the root of the marketing principle, he shows that even in the staples, wheat and meat, demand is elastic, and that successful marketing requires a fine adjustment of production to consumer-demand. He rightly lays stress on the necessity of quality-production and standardization as essential factors, and points out the value of producers' co-operative societies in impressing the importance of these factors on their members. His assertion that the strength of the marketing chain depends on the efficiency of each link is a commonplace which is too often ignored.

From a consideration of principles the author passes to a brief review of the marketing of the more important American crops, namely, grain, cotton, wool, hay, milk, live stock, eggs, apples, peaches, potatoes, and tobacco. It is to be regretted that more space has not been given to the technical and specific problems of commodity marketing, if even at the expense of the more general sections on production and consumption.

In common with most economists the author recognizes the value of co-operative marketing, though he is at pains to set out its limitations. He maintains that co-operation cannot fix prices. But surely no authority has ever said that it could! The undeniable and important fact that co-operation tends to stabilize the price level has been rather lightly treated. Another co-operative impossibility, he holds, is the elimination of the middleman. It would perhaps have been better to emphasize the impossibility of eliminating the middleman's services. The fourteen suggestions of what co-operation can do are lucidly expressed.

The book will be found stimulating and informative to the advanced student of agricultural marketing. It is, on the whole, well arranged, and is full of useful data, with a comprehensive index at the end; the quotations at the beginning and the questions at the end of each chapter are typical of its country of origin. This appears to be one of the best works on the subject that has been recently produced in America.

Potato Varieties. By Redcliffe N. Salaman, J.P., M.D., M.A. (University Press, Cambridge, 1926. 368 pp. Price 25s.)

This work by Dr. Salaman has been looked forward to for some time, and there is probably no other work, certainly not in English, which can compare with it. The author disclaims any attempt to deal fully with

the cultural problem of potato production or the many diseases to which the potato is liable, but neither farmer, plant pathologist, nor seedsman can afford to ignore it. It will be regarded as indispensable to the breeder, who in the past has been too given to use hit-or-miss methods, with the result that the country has been flooded with seedlings which very rarely become of commercial value. Starting with a definition of a potato variety, Dr. Salaman briefly outlines the history of the potato in Europe, from the time Clusius in Vienna received tubers from Spain, and Gerard a year later (1587) obtained another variety, as he states, from Virginia. From these the author traces the development of our present day varieties, giving credit to William Patterson, of Dundee, for introducing the more shapely and better varieties, his masterpiece being the famous Patterson's Victoria, the "blood" of which is in nearly all our present varieties. (It is interesting to note that this variety which has been lost for some years is said to have been reproduced this year from some seed which a Midland breeder has kept for some years.)

Dr. Salaman proceeds to deal with methods of producing new varieties, and the application of genetics to variety raising, a subject on which he has had unique experience. As a result of his researches he is able to discuss the factors controlling shape, quality, maturity, disease resistance, and all the other qualities which go to make up the ideal potato. His account of the relationship between the size of the seed and the size of the crop, together with the amount of ware, as well as on the problem of immature seed, clears up a good deal of misunderstanding, while the chapter on conditions for trials should be read by every experimenter. Space is insufficient to deal with the various chapters on classification, list of varieties, and list of synonyms, or with the value of the leaf index as a means of identification of a variety. The classification will prove useful in expert hands, but the fact that the main groups are based on the flowers may lead to considerable misunderstanding in years when Great Scot and King Edward flower profusely, as they occasionally do.

The book is well illustrated and contains an appendix by Mr. W. H. Parker on yield testing, while a number of pages are arranged so that the characteristics of new varieties can be entered up.

Rural Industries. No. 4, Autumn Number, and No. 5, Winter Number, 1926. (Rural Industries Bureau, 26 Eccleston Street, S.W. 1.)

Lord Ernle, in a foreword to the No. 4 Autumn issue of this quarterly, points out that "Country folk in England stand alone among European peoples in their neglect of subsidiary occupations. An agricultural worker in this country has no pecuniary interest in anything but his labour on the soil." Thus "the overhead charges" on English agriculture are much heavier than in France and Germany, where the cultivators are not divorced from rural industries, and derive from subsidiary employments "that addition to their domestic budget which adds to their material comfort." This seems to confirm the opinion expressed by Mr. Henry Ford in his new book, *To-day and To-morrow*, that farm work alone will not provide for the necessities of the agricultural worker, and, on the Ford farms, small workshops, for the production of nuts, bolts, etc., required in his motor-car factories, provide his farm workers with a remunerative subsidiary industry. Other features of this issue are articles on "The Condition of Village Saddlers" and "Toymaking—An Outlet for the Craftsman," a report on Rural Industries Exhibits at the Agricultural Show, and a further instalment of "The Country Woodworker's Shop."

The Winter Number, 1926, appears in a new cover and with a greatly improved format. Sir Lawrence Weaver contributes an interesting article on "The Ashtead Potters," an admirable under-

taking for employing disabled ex-service men, with which he has been closely associated since its inception. Mr. Gordon Russell writes a breezy note on craftwork from a craftsman's point of view, of which the moral is the freshness, originality and practicability of rural craftwork seen by him compared with the "manufactured" articles seen at an Arts and Crafts Exhibition in a provincial town. Mr. G. E. Marston has a first article on "Design and Taste," power-driven saws are discussed in the woodworker series, and Mr. Marston continues his useful articles on "Toy Making." In its new form, *Rural Industries* is a bright and interesting little magazine. It is now issued at a prepaid subscription rate of 1s. per annum.

ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Adie, R. H.—Chemistry for Agricultural Students. (viii + 357 pp.) London: University Tutorial Press, 1926, 3s. 6d. [54.] [This text-book by the Lecturer in Physics and Chemistry, School of Agriculture, Cambridge, contains the result of many years' experience in the endeavour to show the ordinary student of agriculture how even the most fundamental facts and inferences of Chemistry and Physics have at once a bearing on his practical work and observations.

Herts Institute of Agriculture.—The Aims and Work of the Hertfordshire Institute of Agriculture. (84 pp.) Oaklands, St. Albans, 1926. [374.9 (42).]

Conférence International de Pédologie.—Actes de la IVème Conférence, Rome, Mai 12-19, 1924. 3 Vols. (324 + 727 + 707 pp.) Rome: International Institute of Agriculture, 1926, 40s. [63.11.]

California Agricultural Experimental Station.—Circular No. 304:—Drainage on the Farm. (30 pp.) Berkeley, 1926. [63.14.]

United States Department of Agriculture.—Department Bulletin No. 1408:—Structures used in Draining Agricultural Land. (32 pp.) Washington, 1926. [63.14.]

Orwin, C. S., and Kersey, H. W.—Estate Accounts. (44 pp.) Cambridge University Press, 1926, 3s. 6d. [63.191; 657.]

Malcolm, J.—Agricultural Surveying, including Mensuration, Road Construction and Drainage. (320 pp.) London: University Tutorial Press, 1926, 5s. 6d. [52; 625.7; 63.14.]

Andrews, E. S.—Mechanisms: A Text-Book for the Use of Non-Technical Students. (200 pp.) London: University Tutorial Press, 1926, 3s. 6d. [62; 51.]

Dominion Office.—Report on the Group Settlements in Western Australia. By *W. Bankes Amery*, British Government Representative for Migration in Western Australia. [Cmd. 2673.] (22 pp.) London: H.M. Stationery Office, 1926, 6d. [325 (941).]

Porchet.—L'Électricité rurale: Distribution, Utilisation. (150 pp.) [Encyclopédie des Connaissances Agricoles.] Paris: Librairie Hachette, 1924. [537; 63.17.]

Fisher, R. A.—Statistical Methods for Research Workers. (247 pp.) Edinburgh and London: Oliver and Boyd, 1925, 15s. [311.]

Field Crops

Hunter, Herbert.—The Barley Crop. A Record of Some Recent Investigations. (vi + 166 pp.) London: Ernest Benn, 1926, 10s. 6d. [63.313.]

United States Department of Agriculture.—Department Circular No. 374 :—Winter Field Peas : Their Value as a Winter Cover and Green Manure Crop. (13 pp.) Washington, 1926. [63.32 ; 63.165.]

University College of North Wales, Bangor.—I. Summary of Experiments on the Manuring of Mangels, 1892-1925. (11 pp.) Bangor, 1926. [63.332-16.]

Irish Free State Department of Lands and Agriculture.—Potato Growing for Seed Purposes. Identification of Varieties of Potatoes from Characteristics of Foliage, Flower and Tuber, Selection of Seed, Sprouting, Cultivation, Manuring, Planting and Spraying of the Crop for Maximum Results. (Reprinted from the Department's *Journal*, Vol. XXIV, No. 4.) (52 pp.) Dublin : Eason, 1926, 3d. [63.512.]

University College of North Wales, Bangor.—Experiments with Potatoes, 1925 :—I. Variety Trials with "Once Grown" Seed ; II. Variety Trials with Fresh Scotch Seed ; III. Effect of Age of Seed ; IV. Manurial Trials. (12 pp.) Bangor, 1926. [63.512.]

Oxford University Institute of Agricultural Engineering.—Bulletin No. 2 :—Preliminary Report of an Investigation into the Artificial Drying of Crops in the Stack. (104 pp. + 7 pl.) Oxford : Clarendon Press, 1926, 2s. 6d. [63.198.]

Fruit

United States Department of Agriculture.—Department Bulletin No. 1416 :—Marketing Barrelled Apples. (100 pp.) Washington, 1926. [63.41 : 38.]

United States Department of Agriculture.—Department Bulletin No. 1415 :—Marketing Western Boxed Apples. (96 pp.) Washington, 1926. [63.41 : 38.]

Plant Pests and Diseases

United States Department of Agriculture.—Farmers' Bulletin No. 1483 :—Control of Insect Pests in Stored Grain. (30 pp.) Washington, 1926. [63.27-31.]

United States Department of Agriculture.—Department Circular No. 394 :—Copper Carbonate Prevents Bunt (Stinking Smut) of Wheat. (9 pp.) Washington, 1926. [63.24 ; 63.294.]

Nebraska Agricultural Experiment Station.—Research Bulletin No. 32 :—The Spindle-Tuber Disease as a Factor in Seed Potato Production. (128 pp.) Lincoln, 1926. [63.23.]

Fawcett, H. S., and Lee, H. A.—Citrus Diseases and Their Control (594 pp. + 15 col. pl.) New York and London : McGraw-Hill Publishing Co., 1926, 25s. [63.24-41.]

Live Stock

United States Department of Agriculture.—Farmers' Bulletin No. 1487 :—Practical Hog Houses. (14 pp.) Washington, 1926. [63.64 : 69.]

United States Department of Agriculture.—Farmers' Bulletin No. 1490 :—Hog Lot Equipment. (22 pp.) Washington, 1926. [63.64 : 69.]

Prewett, F. J.—The Marketing of Farm Produce. Part I : Live Stock. (103 pp. + 6 pl.) Oxford : Clarendon Press, 1926, 3s. 6d. [381 ; 63.6 ; 38.]

Byng, Lady Rachel.—How to Make Money by Angora Rabbit Breeding and Wool Farming. (36 pp.) The Author, High Sandhoe, Hexham, 1926, 1s. 3d. [63.69 ; 63.761.]

Dairying

Wye, South-Eastern Agricultural College—Department of Economics.—Investigation into Farming Costs of Production and Financial Results. Report No. 2. The Cost of Food in Milk Production. By James Wyllie, B.Sc. (69 pp.) Wye, 1926. [63.711: 63.714.]

Virginia Agricultural Experiment Station.—Bulletin No. 243:—Dried Apple Pomace with Dried Beet Pulp and with Corn Silage in Feeding Dairy Cows for Milk Production. (11 pp.) Blacksburg, 1925. [63.711.]

Virginia Agricultural Experiment Station.—Technical Bulletin No. 28:—The Comparative Value of Peanut Meal, Cottonseed Meal and Soybean Meal as Sources of Protein for Milk Production. (54 pp.) Blacksburg, 1925. [63.711.]

The Midland Agricultural and Dairy College.—Bulletin No. 9:—County and Inter-County Clean Milk Competitions. Organized by the College and the County Agricultural Education Authorities. Report on the Inter-County Competition, 1925-26. (12 pp.) Sutton Bonington, 1926. [614.32.]

Edinburgh and East of Scotland College of Agriculture.—New Series No 1:—A Pure Milk Supply. (26 pp.) Edinburgh, 1926. [614.32.]

Imperial Economic Committee.—Report on Marketing and Preparing for Market of Foodstuffs Produced within the Empire. Fourth Report: Dairy Produce. [Cmd. 2725.] (148 pp. + 7 charts.) London: H.M. Stationery Office, 1926, 1s. [63.7 (00); 63.70; 38.]

Veterinary Science

International Agreement for the Creation at Paris of an International Office for Dealing with Contagious Diseases of Animals. Paris, January 25, 1924. [British Ratification deposited July 11, 1925.] (19 pp.) [Treaty Series No. 11 (1926), Cmd. 2663.] London: H.M. Stationery Office, 1926, 4d. [614.9 (00).]

Poultry

Leeds University and Yorkshire Council for Agricultural Education.—Bulletin No. 148:—Profitable Poultry-keeping. (16 pp.) Leeds, 1926. [63.651.]

Feathered World.—Ducks. (162 pp.) London: 9 Arundel Street, W.C. 2, 1926, 1s. 6d. [63.657.]

Economics

Benner, C. L.—The Federal Intermediate Credit System. (375 pp.) London: Allen and Unwin, 1926, 10s. [332.71 (73).]

United States Department of Agriculture.—Department Bulletin No. 1399:—Agricultural Survey of Europe: Germany. (112 pp.) Washington, 1926. [31 (28); 338.1 (28).]

United States Department of Agriculture.—Department Bulletin No. 1409:—Agricultural Survey of South America: Argentine and Paraguay. (91 pp.) Washington, 1926. [31 (82); 31 (89); 338.1 (82); 338.1 (89).]

International Institute of Agriculture.—Oleaginous Products and Vegetable Oils: Production and Trade. (192 pp.) Rome, 1926, 15 lire. [664.3; 63.342.]

Legal Handbooks

Millard, P. W.—The Law Relating to Tithe Rentcharge and Other Payments in Lieu of Tithe. Second Edition. (xxxiii + 334 pp.) London: Butterworth & Co. and Shaw and Sons, 1926, 15s. [348.]

Eve, A. M. Trustram.—Memorandum on the Rating and Valuation Act, 1925. (156 pp.) London: Surveyors' Institution, 1926, 2s. 6d. [336.28; 347.]

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NOTES FOR THE MONTH

The Cultivation of Sugar Beet

A CONFERENCE on this subject, under the chairmanship of Lord Clinton, was held at the Rothamsted Experimental Station on January 19, 1927. The following papers were read: Mr. J. M. Van Bommel Van Vloten, sugar beet expert to the Netherlands Sugar Industry, "Continental Experience with the Growth of Sugar Beet"; Mr. T. G. Fowler, commercial manager, Cantley Beet Sugar Factory, "What the Factory Wants and How the Farmer Can Supply It"; Mr. I. J. Schapringer, "The Effect of Climate on the Cultivation of Sugar Beet"; Mr. R. N. Dowling, County Agricultural Organizer, Nottinghamshire, "Experiments with Sugar Beet in the Midland Counties"; and Mr. H. J. Page, "Manurial Experiments with Sugar Beet at Rothamsted and Woburn."

As a result of Continental work, Mr. VAN VLOTEN thought that the drill rows were too wide in England; while wider drills made horse-hoeing easy, reduced the labour requirement for singling and topping, and produced larger roots, these advantages did not compensate for the smaller number of roots per acre. The Continental experiments showed a difference of 6 per cent. in yield between 16 in. drills and 22 in. drills. Mr. Van Vloten compared the return to the farmer from (1) an 11 ton crop of 18 per cent. sugar, (2) an 11½ ton crop of 17½ per cent. sugar, and (3) a 12 ton crop of 17 per cent. sugar, and concluded that a large crop rather than high sugar content should be aimed at. Conversely, from an analysis of factory costs and returns, he concluded that a high sugar content was best from the factory point of view. To reconcile these divergent interests, he suggested that the factory should increase its payments for high sugar content above those at present adopted.

Mr. T. G. FOWLER insisted on the necessity for the contract for beet growing, as it ensured a market to the farmer and

raw material to the factory. The factory insisted on the use of its seed, as this prevented the use of inferior seed; it supplied the seed at as cheap a rate as possible and, in fact, often made a loss on the transaction. It was vital to the continuance of the factory supplies that the farmer should make a profit on his crop; hence the employment of agricultural experts by the factory to advise as to the treatment of the crop. Farmers should do their best to spread their deliveries of beet over as long a period as possible; at present, in spite of contract inducements, the farmer chose the time of maximum sugar content for delivery, with the result that the factory was overwhelmed at this period. Two grave faults of farmers were the supply of insufficiently topped beets and neglect to remove weeds and other rubbish from deliveries. The sugar content of beets grown in this country was highly satisfactory; but, unless the yield per acre was increased from the present average of 8½ tons to 10 or 12 tons, the industry would not survive when the subsidy disappeared. He supported Mr. Van Vloten in recommending to this end narrower drills and singling. He advocated 18 in. drills and 9 in. in the rows. With a full plant, this would produce some 17-21 tons per acre. If necessary, special sugar beet hoes should be used for drills of the width mentioned.

Seeding should be heavy—some 15-20 lb. per acre; the seed should be sown at a depth of 1 in., and rolling should be done before and after drilling. If necessary, a special drill to sow at the heavy seed rate should be purchased. Labour for drilling and singling should be carefully supervised, and drilling should be carried out early.

Mr. I. J. SCHAPRINGER compared the climate of England with that of Central Europe, Canada and the United States in relation to the requirements of the crop, and came to the conclusion that the climate of this country was very well suited to sugar beet, not only as regards rainfall, temperature and daylight, but also in permitting a lifting period extending up to 100 days.

Mr. R. N. DOWLING concluded, from his experiments, that, while sugar beet required considerable quantities of nitrogen and potash, if the soil were already well supplied with these materials, additional quantities would be detrimental to the crop.

Mr. H. J. PAGE recommended 12 tons of dung, 2-4 cwt. nitrate of soda, 2 cwt. superphosphate and 3 cwt. of 40 per

cent. potash salts (or 6-8 cwt. kainit) as the manurial dressing per acre. Neither at Woburn nor Rothamsted was any advantage derived from extra top dressings of nitrogen.

In the discussion that followed the papers, growing on the ridge was strongly advocated by Mr. Luddington; he claimed a yield of 13 tons by this method compared with 9 tons on the flat, with a saving of 50 per cent. in the cost of cleaning, and with easier singling and hand pulling. Mr. A. W. Ling described experiments in the West of England which confirmed Continental results as to width of drills and time of singling. He recommended as nitrogenous dressing 1½ cwt. sulphate of ammonia, with 1 cwt. nitrate of soda as top dressing; excess of nitrogen resulted in large, leafy growth and delay in ripening beyond the lifting period. Colonel Long referred to the benefits from subsoiling.

Sir John Russell pointed out that we were using varieties that best suited Continental conditions, and that the work required to be carried out was to evolve varieties suited to this country. Obviously, much experiment and experience were necessary before disputed cultivation points could be settled; and, until these were solved, there would always be discrepancies in manurial results. On the question of manurial benefit, this depended on the degree of transference from leaves to root.

* * * * * *

Milk Consumption in Elementary Schools

THE growing appreciation of the food value of milk, and its importance in the dietary of children, justifies the following reference to a scheme which has recently been brought to the Ministry's notice. The manager of a progressive dairy in a small town in the home counties has been able to make arrangements with the local committees of the elementary schools to supply Grade A milk to the school children during the morning interval. The scheme, which was started in September last, aims at encouraging the children to drink good milk; it also serves as useful propaganda in the district on the food value of milk; while, from the dairyman's standpoint, it has the advantage of providing an additional opening for the disposal of his liquid milk.

The milk is supplied in half-pint bottles, fitted with crown-cork stoppers. These, previously sterilized, each receive one-sixth of a quart of milk, cooled to 45 deg. F. in summer; while, in the winter, the quantity is one-seventh of a quart,

heated to 110 deg. F. The bottles are dispatched to the schools in boxes, together with a supply of sterilized, natural straws.

Payment is made by means of aluminium tokens, of the face value of one penny, which the children can purchase once a week from the headmaster; and in respect of these tokens there is a simple accounting arrangement between him and the dairyman. The children surrender a token when receiving a bottle and a sterilized straw; and it is practicable for the head of each department to issue the milk, superintend its consumption, and collect the bottles and straws in from five to six minutes. The used straws are destroyed, while the bottles, caps and tokens are washed and sterilized at the dairy, thus ensuring a safe and hygienic milk supply.

The experience is that the children readily drink the milk. This may be due in part to the novelty of taking it through a straw, also to the suitable temperature at which the milk is supplied; but there is no doubt that this milk ration has given increased vigour to the children. The consumption of milk in these schools has risen from 30 bottles on the first day to a daily average of from 350 to 400 bottles at the present time. It is found that more milk is consumed during cold weather, and that the younger children, almost without exception, are regular purchasers. Among scholars over 11 or 12 years of age the consumption tends to be less stable.

The children look remarkably healthy, and it is stated that, since the scheme was started, the attendance has improved and attention to work has been more sustained. The system has another useful purpose, inasmuch as many of the pupils live at a distance of over two miles from the schools; hence the milk ration forms a stop-gap in the rather long interval, for the younger pupils, between breakfast and the midday meal.

The scheme is supplemented by lessons on hygiene and the value of milk as a food, whilst the dairy manager is endeavouring to create an active interest in the local milk supply among the scholars. It is probable that, during the summer months, ice cream may be added or substituted should the children show a marked preference for milk in this form. Much of the success which appears to be attending the venture may be attributed to the care with which the details of the scheme have been worked out, so that no responsibility is placed upon the school staffs for handling or heating the milk. The use of Grade A milk, with sterilized bottles and straws, ensures, also, the wholesomeness of the milk which the children are receiving.

THE following notice to applicants for Orders in Council, under Section 2 of this Act, has been issued to the Press:—

Merchandise Marks Act, 1926

(1) Applications for Orders in Council to require the marking of imported goods with an indication of origin under Section 2 of the Merchandise Marks Act, 1926, should be made to the appropriate department, which is defined in Section 10 (1) of the Act as meaning, in relation to agricultural and horticultural produce and the produce of any fishing industry, the Minister of Agriculture and Fisheries, the Secretary of State for the Home Department and the Secretary of State for Scotland acting jointly, and, in relation to any other goods, the Board of Trade.

(2) Accordingly applications relating to goods of all classes and descriptions other than agricultural and horticultural produce and the produce of any fishing industry should be addressed to the Secretary, Board of Trade, Great George Street, London, S.W. 1.

(3) Applications relating to agricultural and horticultural produce and the produce of any fishing industry should be prepared in triplicate, one copy being addressed to each of the following :—

(*a*) The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

(*b*) The Under-Secretary of State, Home Office, London, S.W. 1.

(*c*) The Under-Secretary of State, Scottish Office, Whitehall, London, S.W. 1.

(4) No applications will be referred by the appropriate departments to the standing committees under the Act which will shortly be appointed unless, in the opinion of the department, the applications substantially represent the interests of either manufacturers, producers, dealers, traders, users or consumers, or of any body of wage-earners.

Broom-rape

WITH reference to the interesting notes on weeds by Mr. E. Wyllie Fenton (p. 1014) it may be observed that the question of the occurrence of the seeds of broom-rape is an important one. In the Ministry's leaflet dealing with this parasitic weed it is remarked that the seeds of broom-rape are practically never found in samples of red clover, and that there is thus little fear of introducing the pest with the clover sown. The seeds of

broom-rape appear to be capable of lying dormant for long periods in the soil, germinating in favourable seasons and when they come into contact with the roots of a suitable "host" plant, such as clover. Mr. Alfred Eastham, the Chief Officer of the Official Seed-Testing Station, states that broom-rape has been reported as being on the increase in a number of counties during the past two years. He has never known the seed to be found in samples of commercial clovers, nor has he any record of it having been actually so found by any other observer. The seed is very small and light, and, in a number of infested fields examined last year, it was found that the broom-rape had ripened and completely shed its seeds before the clover was ready for cutting. Even if a few seed spikes remained until the clover was ready for harvesting, the ordinary processes of harvesting and commercial cleaning should readily remove the seeds. The known capacity of broom-rape seed to retain its vitality in the soil for a considerable number of years, together with the scattering of the light seed by the wind, might explain the distribution of the parasite more or less evenly throughout an infested field. This is borne out by a case brought to Mr. Eastham's notice in 1925, in which a field of experimental plots had been sown down with small quantities of red clover obtained from various leading firms of seedsmen. Broom-rape was subsequently found in all the plots, and to about the same extent; but it is inconceivable that all the samples sown could have been contaminated. No clover had been grown in the field for eight or nine years, and the evidence points to the contamination being from the soil in this case.

At the present time the Official Seed-Testing Station is paying special attention to the question of broom-rape, and, as a result of experiments in progress, it is hoped to obtain more definite evidence as to the possibility of its seed being distributed in bulks of commercial clovers.

Sales of Horticultural Produce on Commission

THE Horticultural Produce (Sales on Commission) Act, 1926, which received the Royal Assent on December 15 last, provides that where, in the case of any horticultural produce defined as vegetables, fruit, flowers and plants consigned for sale on commission, the salesman makes a charge by way of commission or otherwise, he shall enter in a book, kept by him for the purpose, the names of the owner or consignor of the produce,

and of every purchaser and the price paid or agreed to be paid by each purchaser. Further, that, as soon as practicable after the sale, the salesman shall furnish the owner or consignor with an account showing the actual price paid or agreed to be paid for the produce, and, where there is any variation in price, the number, weight or quantity sold at each price. The account must also show the amount of the commission or charge made for selling, and any charges, with details, made for services in connexion with the sale, as well as of any sums paid by the salesman on behalf of the owner or consignor in connexion with the sale, with details thereof. These provisions apply to all sales, whether to third parties or where the goods are purchased by the salesman or by any person on his behalf. For failure to comply with these requirements, or for the rendering of an account that is false in any material particular, there is a penalty, upon summary conviction, of a fine not exceeding £20 for a first offence and of £100 for a subsequent offence.

It should be noted that the provisions of the Act do not apply unless the owner or consignor of horticultural produce has forwarded to the salesman, prior to the sale, an advice note specifying the nature, description and contents of the packages consigned. For the purposes of the Act, all produce consigned shall be deemed as consigned for sale on commission, unless at or before the sale the owner or consignor sends the salesman a written intimation to the contrary, or has entered into a written agreement with him to that effect. Such agreement may apply to a particular consignment or generally to all consignments specified in the agreement. Where the owner or consignor has appointed an agent for the purposes of the Act, anything authorized or required to be done by the owner or consignor may be done by such agent.

The owner or consignor may, within ten days of the receipt of an account, require the salesman, by notice in writing, to produce for the inspection of an accountant of approved qualifications any records, book or document relating to the produce referred to in the account. Refusal to produce such records, etc., their destruction or obliteration, or the obstruction of the accountant in his work of inspection, may entail a penalty, upon summary conviction, of a fine of £20.

Copies of the Act (16 and 17 Geo. 5, Ch. 39), which applies to England and Wales and Scotland, but not to Northern Ireland, may be obtained, price 1d. net, from H.M. Stationery Office.

Agricultural Economics as a General Subject of Study

AN innovation in the Department of Economics at Bristol University is the inclusion in the courses of study for 1926-27 of a special course on the Economics of British Agriculture as one of the selective subjects for the degree of B.A. with Honours in economics. The point of this notable departure is the fact that the subject is part of the curriculum for students of general economics, and would be taken by them in the third and fourth years of study; it has no connexion with the teaching of agricultural science and practice, although the Department of Agriculture is naturally concerned in the particular arrangements for the course. The syllabus outlines five sections of study for the course as follows:—(1) Demand for Agricultural Products and Sources of Supply; (2) The System of Agricultural Production, embodying types of farming, factors of production, farm organization and marketing; and (3) Analysis of the System, dealing with prices and farming practice, the conditions which influence net output, the effect of State policy, co-operation and individual efficiency, the distribution of net output, and the effect upon supply of factors of production. Section (4), Rural Sociology, is concerned with rural communities and their social organization, rural industries, comparison of rural and urban conditions, also emigration and immigration. The last section, (5) The Nation and Agriculture, deals with the present position of agriculture, possible objectives and methods of attaining them, and problems of the future.

* * * * * *

International Congress of Agriculture, 1927

THE thirteenth International Congress of Agriculture will be held at Rome from May 23 to May 28 next, under the patronage of H.M. the King of Italy. The programme of the Congress is divided into six sections as follows:—Section I.—International Conference of Agricultural Associations; topic, "The Position of Agriculture and the Work of Agricultural Associations." Section II.—Agricultural Cultivation and Industry; topic, "The Cultivation of Cereals from an Economic and Social Point of View." Section III.—Zootechnics; topic, "The Problem of the World Production of Meat and Milk from an Economic and Social Standpoint." Section IV.—Training and Co-operation in the Agricultural Industry; topic, "The Scientific Organization of Agricultural Work."

Section V.—Agricultural Geology and Climatology. Section VI.—Women's Section, dealing with women's organizations in rural districts, domestic economy training for rural women, and the development of rural life. In addition there will be certain general conferences. Some excursions have also been planned to places of interest, of which a definite programme will be issued separately. The Ministry has a supply of the official programme, copies of which will be sent to those interested on application to the Secretary, 10 Whitehall Place, S.W. 1.

National Diploma Examinations, 1927

THE regulations and syllabus for this year's National Diploma Examinations in Agriculture and in Dairying, under the auspices of the National Agricultural Examination Board, are now available, and copies can be obtained from the Secretary, Royal Agricultural Society of England, 16 Bedford Square, London, W.C. 1, or from the Secretary, Highland and Agricultural Society of Scotland, 3, George IV Bridge, Edinburgh.

The examination for the National Diploma in *Agriculture* takes place at Leeds University on March 31 and following days. To be eligible for admission to this examination, candidates must present certificates from a recognized college for certain specified subjects; and, before the practical agriculture and farm machinery papers are taken, must produce evidence of having resided on a farm for a complete year of farming operations. The nine papers in the examination may be taken at one time, or a group of three, four or five in the first year and the remaining subjects within the next two years. Applications to sit for the N.D.A. examination must be sent in not later than Monday, February 21, 1927.

The examination for the National Diploma in *Dairying* will be held in September next, at Reading for English candidates, and at Kilmarnock for Scottish candidates. As a preliminary to examination, entrants must have spent not less than six months on a dairy farm, have had at least six months' training in practical dairy work at an approved institution, and have attended approved courses in chemistry, bacteriology and botany. The revised regulations and syllabus for this examination, of which notice was given twelve months ago, will not come into force until 1928.

SOME DISCOVERIES IN THE TREATMENT OF SUGAR BEET

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THE purpose of this article is to give some account of the improvements which have resulted from recent researches into the desiccation method of producing sugar from sugar beet.

The Institute of Agricultural Engineering, University of Oxford, has been engaged upon this study for some time, and has issued a brief report* on the progress of the work. In this report was given a general description of what had been done to date, together with certain mechanical and economic data. This information will be amplified in a full report to be issued shortly. In the meantime it has been considered advisable to give some further description of the actual improvements effected. A brief account of earlier attempts to solve the problem of desiccating sugar cane and beet has been included. The development of the art of drying, particularly of agricultural products, has made it possible to pursue a more searching study of the difficulties which confronted earlier investigators, and to apply more recently discovered physical and mechanical knowledge to the elucidation of the problem.

Historical : Sugar Cane.—The problem of drying sugar cane, with the object of preserving the crop and storing the dried material for future treatment, has been under investigation since early in the nineteenth century. In 1811 Gotting pointed out the potential advantages of drying shredded sugar cane for transport and export. A number of patents appeared subsequently, notably the Newton patent of 1848, and dried shredded cane was actually imported into France in 1850 by Daubrée. A method of shredding and drying cane was patented in the United States in 1908 by McMullen. After the extraction of the sugar the bagasse was used for the manufacture of paper. In 1910 cane was shredded and desiccated in Cuba and shipped to the United States for the purpose of extraction. A patent was taken out in France in 1912 for the desiccation of cane or beet. About half the juice was extracted by milling and the partially exhausted material was dried by hot air from which part of

* *Investigations into the Desiccation (De Vecchis) Process for Producing Sugar from Sugar Beet.* Progress report by B. J. Owen, M.A., D.Sc. Published by H.M. Stationery Office, 1926, price 4d. net.

the oxygen had been extracted. In the same year a patent was taken out in England for drying shredded cane in a revolving cylinder, heated by combustion gases. A number of other patents of minor importance connected with cane drying are traceable in England and France, as well as in America. Attempts have also been made in different countries to dry cane in the sun for export purposes.

It has been found, however, that the treatment of cane, as compared with beet, is attended with greater risks to the final product, and it is now recognized that dried shredded cane has not been successfully utilized on a commercial scale in the sugar industry.

Sugar Beet.—The question of drying sugar beet has been under consideration on the Continent and elsewhere during the last 75 years. Although extensive experiments have been conducted during this period, it has, until recently, been understood in the sugar industry that the desiccation of beet for the purpose of sugar production had not been effected on a commercial scale with any real measure of success. The first effort to dry beet was made in Germany, in 1850, by Schützenbach, who proposed to treat sliced dried beets with milk of lime in a series of troughs in which the material was macerated and specially prepared for extraction. The process appears to have been unsuccessful owing to technical difficulties in the drying. This method was followed in Germany by a number of other processes, advocated by Trobach, Weichmann, and others, all of which have proved equally unsuccessful for the same reason.

An important endeavour to dry beet was made in 1901-3 by Lafeuille, who experimented on a large scale in Egypt, Spain, Italy, and France. The drying of the beet cossettes was attempted by various methods—exposure to the sun, heated air, and carbonic acid gas. These experiments were on the whole unsatisfactory, due partly to the resulting invert sugars and dark coloured juices, and Lafeuille abandoned the work. He has since devoted himself to the drying of beets for other purposes, such as cattle food. A later attempt was made in France, in 1910, by Daubreband, who subjected whole beets to a strong current of hot air in order to separate the rind from the flesh, and to dry the beets so treated, after slicing, at progressively rising temperatures. This was not specially for sugar making, but for foods.

The problem was also investigated in the United States in 1914, by Benjamin, who proposed to dry sliced beet at a relatively

low temperature, until 90 per cent. of the moisture was removed, with the object of coagulating the albuminoid matters without causing the rupture of the cells, the sugar being subsequently extracted in diffusion vessels. The information as to the results obtained by Benjamin is meagre, but it is known that his process has not been successful owing to inefficient drying.

The De Vecchis Process.—Dr. De Vecchis has, since 1923, conducted practical tests based on his research work, and claims to have evolved a process which produces better and more economical results than those obtained by previous attempts. By his process the fresh beets are first cleaned and sliced. The sliced beets are then desiccated in a drying chamber. After desiccation the cossettes are placed in lixiviation vessels, into which warm water is introduced and a thick juice produced. This raw juice is purified with lime and superphosphate and then passed through filter presses. The remaining processes are similar to those practised in the diffusion method.

The De Vecchis process of drying consists of two distinct stages. The first reduces the moisture content from about 80 per cent. to 5 per cent. The second stage is said to effect the coagulation of the albuminoids and to cause disruption of the cellular membrane of the beet; coagulation is said to be obtained by applying heat at a limited temperature over a definite time, and, if this operation is not skilfully performed, caramelization occurs with consequent deterioration of the sugar content.

The report of a Commission of Enquiry, appointed by the Ministry of Agriculture, indicated that the process was, at the time of the Enquiry, defective because of inefficient drying.*

Experiments at Oxford and Eynsham.—The nature of further researches, conducted at Oxford and Eynsham by the Institute of Agricultural Engineering, University of Oxford, is outlined in the *Progress Report on the Investigations into the Desiccation (De Vecchis) Process for Producing Sugar from Beet.*

The importance attached to the desiccating operation is emphasized in the *Report of the Commission of Enquiry on the De Vecchis Beet Sugar Process*, and the suggestions

* *Report of the Commission of Enquiry on the De Vecchis Beet Sugar Process.* [Cmd. 2343.] H.M. Stationery Office. Price 9d.; post free 10d.

contained in it as to the manner in which the De Vecchis drying method could be improved, are confirmed by the Progress Report. In the introduction it is stated that: "A considerable amount of work had already been done by the Institute on the dehydration of vegetable materials, and information had been obtained which, it was thought, might be used as a means of effecting improvements in the technical working of the process, particularly in regard to its adaptation to small scale operations."

Other extracts from the Progress Report show the scope of the experimental work and its practical possibilities :—

The particular effects of the second phase claimed by the inventor (De Vecchis)— the coagulation of the albuminoids and the rupturing of the cell membrane of the beets—have been examined. The result was to suggest that this second stage might be dispensed with entirely; if this were possible, there would be avoided a tendency associated with this second stage towards the formation of invert sugar and caramel, and, moreover, it should be possible to make use of a simple drier.

From the preliminary investigations and laboratory trials in the drying of beets, it appeared that a simplification might be effected by using the method already applied in the drying of agricultural crops. In this way it was expected that the initial cost of the drying apparatus might be reduced. The first experiment conducted on a practical scale indicated that this type of drying possessed definite advantages. It was found that, providing the drying was done rapidly and within the limits of critical temperatures, there was no formation of caramel or invert sugar. Further experiments have shown that this mass-drying could be used on a larger scale for factory operations.

An experiment with disintegrated cossettes tended to show that still stronger syrups could be extracted in a continuous lixiviator as distinct from the battery at present installed. This would have the further advantage of simplifying the whole process.

An endeavour, therefore, is being made to standardize a [purifying] process which can be used in an equally satisfactory manner with all classes and strengths of syrups without any material addition to plant or labour.

The laboratory work, together with the practical operation in the factory, showed clearly that the drying could be effectively controlled by using the principle discovered in the drying of all vegetable matter as evolved by the Institute and Mr. Charlie Tinker, of Kilmartin, Inverness. It has been found that the methods suggested by previous investigators, with perhaps the exception of Benjamin, were conducted upon wrong hypotheses, namely, the drying of the beet to exhaust most of the moisture for the complete coagulation of the albuminoids, and the rupture of the cellular walls. It has been found that there is no rupture of the cellular walls and that prolonged heat coagulation is not essential. Furthermore, there is no such action as lixiviation; the cellular walls are not ruptured, consequently there is only simple diffusion.

These discoveries, which appear to be fundamental, have resulted in producing practical applications, either in the form of a process or apparatus. They may be grouped under the following heads :—

(*a*) Drying.

(*b*) Extraction.

(*c*) Purification.

(*a*) **Drying.**—The desiccation of beet, previous to the extraction of sugar, had not, up to the time of the Institute's experiments, been effected on a practical scale with any substantial measure of success by the various methods described, not excepting the De Vecchis process, where the beets were cut into fragments and dried by progressive heating to about 100° Centigrade, and kept at this temperature until the albuminoids were said to be completely coagulated, the walls of the cells cracked, and the cossettes sterilized, the cossettes so treated being afterwards lixiviated with hot water. It was discovered in the course of the present experiments that the initial drying of the fresh beets and the subsequent heating of the dried cossettes, as advocated in the De Vecchis process, were not necessary, and that the second stage of the process, to which the production of these results is ascribed, is unnecessary.

The method introduced by the Institute consists in desiccating the cossettes by means of a drying agent, such as heated air, continuously and uniformly applied until the temperature of the cossettes is raised to about 200° Fahrenheit, and the moisture content reduced to approximately 5 per cent. of the weight of the material. This single desiccating operation causes the sugar-containing cells of the cossettes to be affected in such a way, and the albuminoids rendered insoluble to such an extent, that the sugar contained in the cossettes can be readily and effectively extracted. The resulting sugar juice possesses a higher degree of purity and concentration than raw juices obtained before the introduction of this method of drying.

The cossettes must be treated either in mass or in layers. The conditions under which the drying agent is applied are varied to suit the particular conditions under which the desiccating process is conducted. The principle underlying this method of treatment is based upon that which governs the drying of agricultural crops, which has been fully described

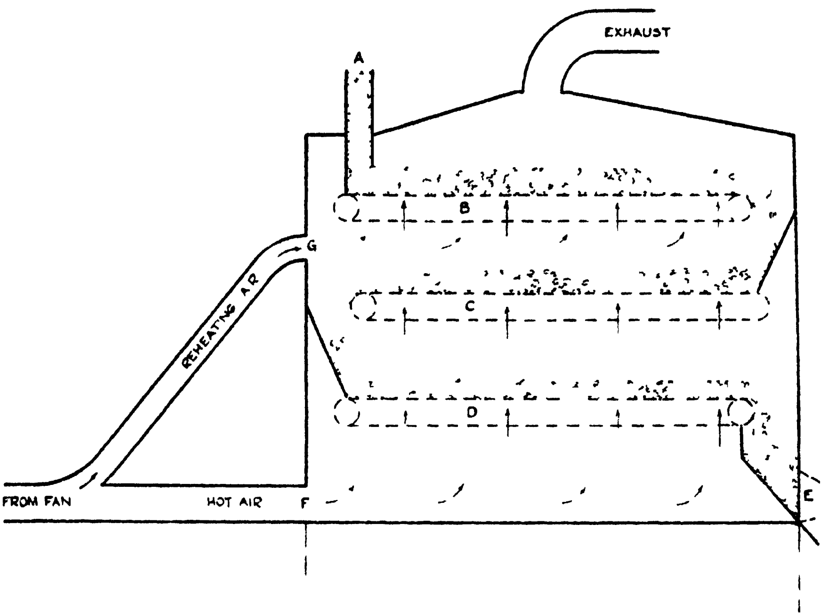

FIG. 1 —Continuous Mass Drying for Factory or Farm

in the report* on this subject published by the Institute. Some of the methods † to which the principle, as adopted for the drying of sugar beet, has been used by the Institute, are given.

Figs. 1, 2, and 3 show some of the methods of drying employed by the Institute.

Continuous Mass Drying (*Fig.* 1).—The diagram illustrates a type of conveyor drier. Dr. De Vecchis used a drier having five conveyor belts for two-stage drying. The second stage was for the purpose of coagulating the albuminoids. The drier, as shown in the accompanying diagram, consists of three belts placed one above the other and enclosed in a suitable casing.

A chain drive on the outside of the casing actuates the belts, which travel at different speeds. The freshly sliced beet is fed at the top of the drier through a hopper (*a*) and falls in a mass directly on to the end of the top belt (*b*), which carries it along to the further end. Here it falls on to the second belt (*c*) which carries it back through the length of the drier until it falls on to the bottom belt (*d*). The bottom belt carries it along to a discharge (*e*) at the opposite end of the drier. Hot air is introduced at the lower portion of the drier as shown at (*f*), and passes through the layers of beet on the bottom two belts (*d*) and (*c*). A supply of reheating air is introduced between the two top belts as shown at (*g*). This supply of reheating air is for the purpose of raising the temperature of the first supply which has been reduced

* *Preliminary Report of the Investigation into Artificial Drying of Crops in the Stack*. Institute of Agricultural Engineering, University of Oxford. Published by the Clarendon Press.

† The patents governing the process are the property of a private company registered as Sugar Beet and Crop Driers, Ltd.

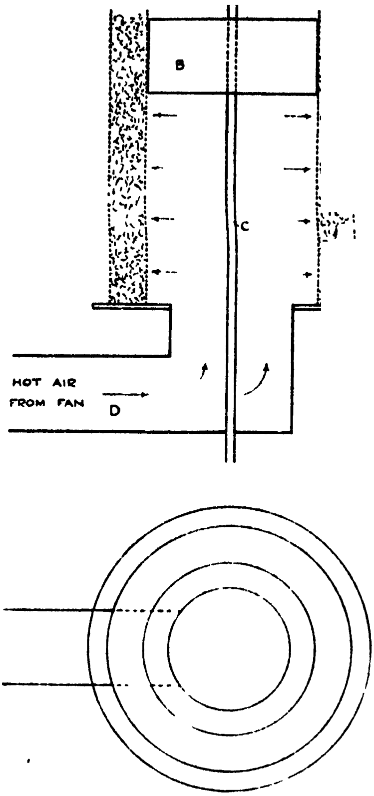

FIG. 2.—Mass Drying in Stack for Factory or Farm.

by its passage through the mass of the beet. The air, after passing through the top layer of beet, is exhausted to the atmosphere, completely saturated. The drier is provided with suitable air-locks at the ends of the belts to prevent the short-circuiting of the air.

Stack Drying (*Fig.* 2).—The diagram shows the method adopted for the drying of cossettes in a stack. A cage of wire mesh was constructed on a platform (*a*) in the form of an annular ring; the central portion of the ring was provided with a circular damper (*b*) fitted on to a vertical screw (*c*). An air duct (*d*) was provided, which delivered the hot air to the centre of the cage as shown. The cage was filled with beet, through which hot air was then blown from the inside of the cage to the outside. As the beet contracted while drying the circular damper was lowered by means of the screw.

Mass Tray Drier (*Fig.* 3).—This type of drier consists essentially of a low staging on which are placed a number of trays.

The space underneath the staging is divided into a number of compartments as indicated by the cross section. The object of this is to control the temperature of the air passing up through the beet so that the air at the highest temperature passes through the wettest beet.

The staging is arranged on a slight incline to facilitate the easy movement of the massed beet, which has a depth of from six to eighteen inches. Rollers are also provided to enable the trays to move along the staging with greater ease.

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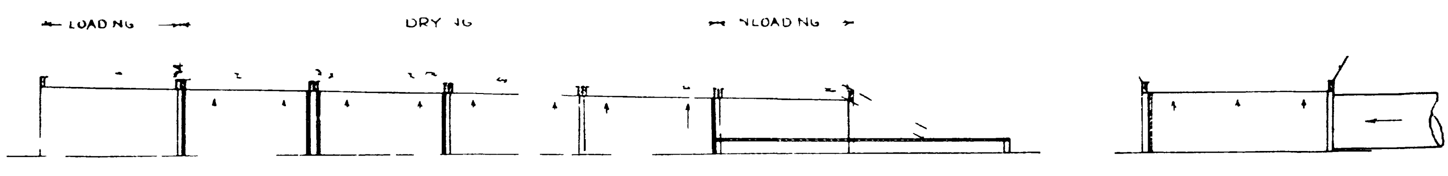

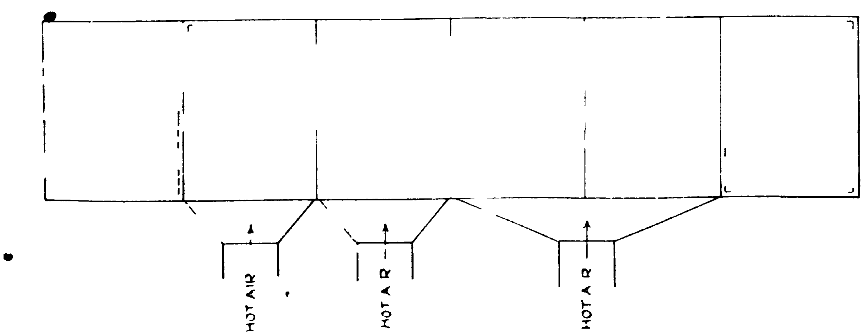

Fig. 3. A simple Mass Tray Drying Device for farm or factory

(Plan and longitudinal section above, cross section at right hand corner.)

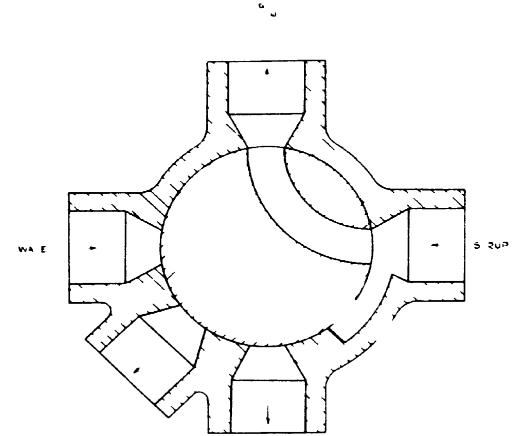

Fig. 5. Multiple Way Cock

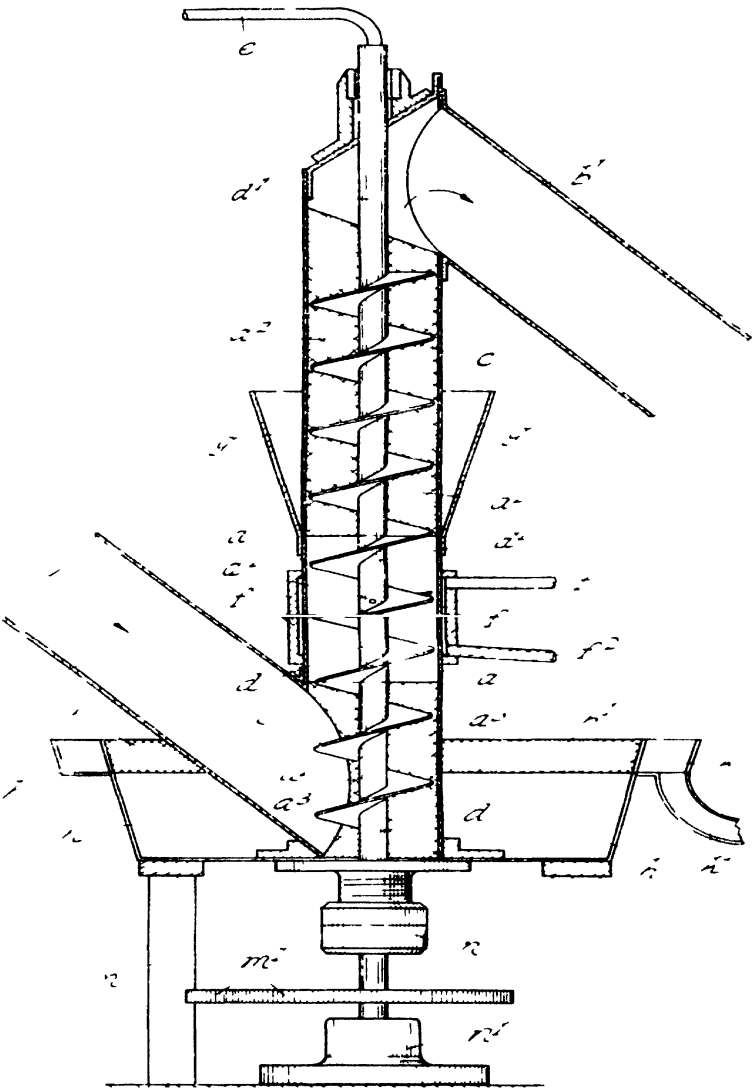

Fig. 4 Continuous Diffuser Extractor

The Fresh Beet End of Tray Drier, showing Air Heater

The Dri I B t Ir I t Tray Drier

Bagging the Dried Cossettes from the Tray Drier

The number of trays is two more than the number of heating compartments; one of these is being filled with fresh beet while the other is being emptied of dry. The trays are of wire mesh with a wood frame to allow of the free passage of the heated air up through the beet.

Generally.—When the sliced beets are treated in comparatively large or small masses, as in the conveyor, the stack or the tray apparatus, the desiccating operation is effected to the best advantage by controlling the consolidation of the mass of material, and promoting slight natural reactions, by supplying the drying agent to the mass at certain ranges of temperature, pressure, and volume which are selected and co-ordinated, so that the rate of dehydration is increased to the greatest possible extent, and the effects of the smallest exothermic reaction are utilized to the best possible advantage.

In cases where the cossettes are desiccated in masses of relatively small thicknesses or in layers or beds, the treatment is equally successful. The conditions as to temperature, pressure, and volume under which the drying agent is passed through the material, the thickness of material, and the time which it is subjected to the drying agent, are determined and proportioned so that the material is dehydrated as advantageously and economically as possible, and is not heated to a dangerous or injurious temperature during the process.

By means of the treatment the cossettes are reduced to a suitable condition for successful extraction without the danger of undue caramelization of the sucrose in the beet, or undue conversion of that substance into invert sugar. Moreover, the cossettes can be treated without the provision of elaborate and expensive drying plants, and the desiccating operation can be carried out satisfactorily in the field as well as in factories, with the further advantage, in the former case, that the cossettes can be transported after treatment at a considerably lower cost as compared with the cartage of heavy fresh beets.

(*b*) **Extraction.**—An extracting or diffusing apparatus was designed, having for its object the provision of means whereby the process of exhausting the cossettes and obtaining the sugar in the form of a syrup can be carried out in a continuous operation and in an effective and expeditious manner. This apparatus consists of a vertical extraction vessel to which the material is fed continuously and impelled upwards and exhausted by means of a counter-current of water, which is caused to gravitate continuously through the ascending material. Means are also provided for straining and collecting

the resulting liquor or syrup and for draining and discharging the exhausted material from the extractor, and for enabling the extraction to be conducted at a suitable temperature.

The accompanying illustration (Fig. 4) shows the apparatus in sectional elevation:—(*a*) is the vertical cylindrical extraction tube (shown broken off as to its major central portion), which is provided towards the base with a suitable aperture or cut-away portion (a^1), by way of which the material is continuously fed from an inclined chute (*b*) into the tube. The material so fed is delivered on to a revolving helical worm (*c*), which substantially fills the interior of the extraction tube (*a*) and causes the material to ascend continuously along the spiral path formed by the helical worm. The internal helical worm (*c*) is furnished with an actuating shaft (*d*), which passes through the centre of the apparatus and is driven from any suitable power.

The upper portion (d^1) of the central shaft (*d*) is hollow, and extends beyond the extraction tube (*a*) and the helical worm (*c*) to the uppermost part of the apparatus, the hollow portion (d^1) being connected at the upper end by a pipe (*e*) to the source of supply, as for instance a constant level tank (not shown), which supplies the exhausting water. The hollow portion (d) of the central shaft (*d*), by way of which the water or solvent is introduced into the apparatus, is provided on the lower part with a series of circumferential perforations (d^2) through which the water or other solvent passes into the extraction tube (*a*) so that the water is caused to gravitate continuously along the spiral course of the helical worm (*c*), and to mix effectively with the material ascending within the extraction tube. The extraction tube (*a*) is surrounded by an outer annular jacket (*f*), which extends from the aperture portion (a^1) of the tube to the level of the perforations (d^2) in the hollow portion (d) of the central shaft (*d*), so that the major portion of the extraction tube (*a*), within which the exhausting operation actually takes place, may be brought to, and maintained at, the temperature at which the material can be treated to the best advantage. The annular jacket (*f*) may be supplied with steam or any other suitable heating medium, according to the particular requirements, and is provided for the purpose with an upper inlet pipe (f^1) and a lower drain pipe (f^2).

The extraction tube (*a*) is formed above the annular jacket (*f*) with an upper extension (a^2) which encloses the lower part of the hollow portion (d) of the central shaft (*d*), and the upper part of the helical worm (*c*), and which is circumferentially perforated to enable the exhausted material to be drained of its excess moisture before being discharged. The water so drained is collected by an external gutter (*g*), provided on the perforated extension (a^2) of the extraction tube (*a*), and may be returned to the source of supply for further utilization within the tube. The extraction tube (*a*) terminates at the uppermost portion in a slanting chute (b^1), by which the exhausted material is discharged.

The extraction tube (*a*) is mounted in a tank or vat (*h*), which is placed at the lower part of the apparatus. Its height is such that the upper level is sufficiently low to permit of the observation and regulation of the material fed into the apparatus.

The lower part of the extraction tube (*a*) is circumferentially perforated as shown (a^3) to allow the liquor to drain into the tank. The upper part of the tank has an annular strainer (h^1), through which the collected liquid passes and flows into an external gutter, whence the strained liquid passes out of the apparatus through a pipe (h^2).

The collecting tank is supported on a platform (m) so that the central shaft (d) can be extended below to permit of its being conveniently mounted and driven. Thus the lower portion of the central shaft (d) can be passed through a stuffing box (n) and provided with driving gear (m^1) and can be mounted in a lowermost thrust-bearing (n^1).

This method supersedes those formerly employed in extracting the sugar by lixiviation.

A multiple-way cock was invented for the regulation and diversion of the flow of different liquids in connexion with the diversion vessels; but it can be used for all forms of work necessitating the distribution and regulation of liquids of varying densities. The construction is shown in Fig. 5.

(c) **Purification.**—The Institute has elaborated a process for purifying or defecating sugar juice or syrups. Its object is to simplify and expedite the treatment of the raw juices obtained, and to produce a final liquor which is more highly purified and more readily crystallizable than that obtained by former processes.

The process consists, first of all, in acidifying the crude syrup and subsequently rendering the acidified syrup alkaline to such a degree that the colloids and other impurities which interfere with crystallization are precipitated, and that the final liquor when filtered can be crystallized without further treatment.

In putting the process into practice the raw juice is first treated with a quantity of calcium superphosphate. The acidified syrup so obtained, after being warmed to a temperature of about 80° Centigrade, is then treated with a quantity of slaked or unslaked lime, which so exceeds that required to neutralize the acidity produced by the first treatment that the syrup is rendered adequately alkaline to effect the precipitation of the impurities. The excess of alkalinity of the syrup may, if required, be afterwards adjusted by the addition of further calcium or lime superphosphate so as to bring the final liquor to a suitable condition for boiling in vacuo and crystallization.

By means of the process the decolorizing properties of the superphosphate, the acidity of which has no appreciable effect on the invert sugar content of the juices or syrup, can be utilized to the best advantage, with the result that the liquors produced possess a better colour and a greater brilliancy as compared with those hitherto obtained. A subsequent development has led to the employment of mechanical separation preceding the chemical treatment.

The process consists in clarifying the raw juices by mechanically separating the slimy and other undissolved or suspended matters from them and in defecating the juices so clarified by the addition of substantially dry tricalcic sucrate or dry calcium hydrate, the clarified juices being either first acidified and subsequently alkalified or first alkalified and then acidified, and finally brought, as required, to the requisite degree of alkalinity and filtered.

In practice the raw juices are warmed to an appropriate temperature and clarified in a centrifugal separator. The clarified juices may, after further heating, be defecated by adding a proportionate quantity of calcium superphosphate or sulphurous acid, followed by a suitable quantity of substantially dry tricalcic sucrate or dry calcium hydrate. The alkalinity of the juices is finally adjusted by the addition of a further quantity of the superphosphate or acid. When the clarified juices are defecated in the reverse order, that is, when they are alkalified and then acidified, the acidity, if any, of the juices may be corrected by the addition of a further quantity of the tricalcium sucrate or calcium hydrate adapted to produce the requisite final degree of alkalinity.

The process, besides ensuring that the defecated juices can be readily filtered under comparatively low pressure, irrespective of their density or viscosity, further ensures, by the utilization of tricalcic sucrate or calcium hydrate, that, substantially, no water is added to the juices during defecation. Hence raw juices of relatively high density can be easily purified by the process and directly treated in single-effect graining vacuum pans, under conditions which do not necessitate any unduly prolonged boiling and which ensure a highly economical evaporation. Moreover, when tricalcic sucrate is used, the raw juices, besides being alkalified without the addition of water, are strengthened in their sugar content in proportion to the quantity of sucrate employed.

These two methods of purification form a completely new process for the subsequent treatment of the diffusion juice, eliminating the difficulties found in the previous processes for the after treatment of the dried cossettes.

THE RELATIONSHIP BETWEEN THE BACTERIOLOGICAL CONTENT AND THE KEEPING QUALITY OF MILK

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National Institute for Research in Dairying.

CLEAN Milk Competitions have now been in existence for six years. It seemed, therefore, advisable to gather together the statistics concerning the results of the bacteriological examinations, and of the keeping qualities of the samples, that their bearing one upon another and their importance to the milk industry might be demonstrated.

In order that this might be done, the figures obtained from the following competitions have been tabulated, and summaries of the results are given in Tables I and II.

Kent ..	.. 1923 and 1924	Surrey	.. 1924 and 1925
Bucks ..	.. 1924 and 1925	Berks ..	.. 1924 and 1925
Midland	.. 1924 — 1925	Somerset	.. 1924 — 1925

A total of 10 competitions and 2,476 samples.

In considering the figures shown in the Tables, it is necessary to bear in mind the fact that the conditions on the farms varied very much, and that, while the vast majority of the samples were cooled, some were not cooled before being dispatched. Again, it was not always possible to examine the samples at the prescribed age (22 to 26 hours), and thus it is found that a few were examined at ages which varied between 18 and 30 hours. Moreover, there was no control over the temperatures at which the samples were kept during transit. Lastly, all laboratories did not possess incubators at a constant temperature of 60° F. for the study of the periods of sweetness of the samples ; and there is little doubt that in some cases the figures for " sweetness " are higher than they would have been had this been done.

Improvements in methods, which will reduce these sources of error, are constantly being made both on the farms and in the laboratories ; the continuance of the statistical records will rectify the inaccuracies of the averages, which are only introduced here in order to make clear the general trend of the results which are being obtained.

Consideration of Tables I and II.—Table I is divided into two parts. On the one side are shown the number of samples, of

which the bacteriological counts fell within certain limits and in which B. coli were not found; on the other the samples with similar counts, but in which B. coli were found to be present in any dilution up to 1/1,000.

TABLE I

Count	B. Coli not found in 1 c.c.			B. Coli present in any dilution up to 1/1,000		
	Samples	Total hours sweet	Av. hours sweet	Samples	Total hours sweet	Av. hours sweet
0 — 1,000 ..	304	23,547	77	44	3,201	72
1,001 — 5,000 ..	362	25,119	69	149	9,753	65
5,001 — 10,000 ..	163	11,004	67	133	8,322	62
10,001 — 30,000 ..	167	11,439	68	248	14,859	59
30,001 — 50,000 ..	62	3,690	59	115	6,602	57
50,001 — 100,000 ..	55	3,342	60	133	6,708	50
100,001 — 500,000 ..	72	4,014	55	260	12,411	47
500,001 — 1,000,000 ..	9	510	56	72	3,324	46
1,000,001 and over ..	16	882	55	112	4,365	38
TOTAL	1,210	—	—	1,266	—	—

If this Table be studied it shows :—

(1) That there is a steady fall in the period of sweetness of the milk as the bacteriological count increases, even though B. coli be absent. Thus milk with a count of 0 to 1,000 and no B. coli, had an average keeping quality of 77 hours, whereas the samples which contained more than 50,000 colonies did not show an average sweetness of more than about 60 hours.

(2) At every stage, the presence of B. coli had a deleterious effect upon the keeping quality of the milk; thus samples, which gave counts of 0 to 1,000 and no B. coli, had an average keeping quality of 77 hours; the average of those which showed the presence of B. coli was five hours less; similar results were obtained in the remainder of the series. Further, it appears to be possible that, within limits, a higher bacteriological count, in the absence of B. coli, has a less deleterious effect upon the keeping qualities of milk than a lower count when these organisms are also present. For example, the samples which gave counts of 30,000 or less and no B. coli, had a longer average keeping quality than those which gave counts of 1,001 to 5,000 but showed the presence of B. coli.

(3) One of the great functions of the bacteriological examination of milk samples is that the influence of the bacteriological content upon the probable keeping qualities of

TABLE II

Count		B. Coli present in 1 c.c., but not in higher dilutions			B. Coli present in 1/10 c.c., but not in higher dilutions			B. Coli present in 1/100 c.c., but not in higher dilutions			B. Coli present in 1/1,000 c.c. Higher dilutions not tested		
		Samples	Total hours sweet	Av. hours sweet	Samples	Total hours sweet	Av. hours sweet	Samples	Total hours sweet	Av. hours sweet	Samples	Total hours sweet	Av. hours sweet
0 —	1,000 ..	30	2,262	75	13	873	67	1	66	66	None	Found	—
1,001 —	5,000 ..	89	6,012	67	33	2,3[illegible]9	61	19	1,236	65	3	186	62
5,001 —	10,000 ..	65	4,368	67	37	2,286	61	28	1,566	55	3	168	56
10,001 —	30,000 ..	113	7,041	62	79	4,602	58	37	2,232	60	19	984	51
30,001 —	50,000 ..	32	1,914	59	44	2,598	59	25	1,380	55	14	714	51
50,001 —	100,000 ..	39	1,989	51	41	2,073	50	26	1,296	49	27	1,350	50
100,001 —	500,000 ..	38	1,742	45	56	2,811	50	65	3,201	49	101	4,641	45
500,001 —	1,000,000 ..	9	480	53	10	504	50	18	894	49	35	1,446	41
1,000,001 and over	..	2	78	39	12	540	45	14	630	45	84	3,117	37
		417	—	—	330	—	—	233	—	—	286	—	—

TABLE III

LABORATORY I Temperature of incubator variable				LABORATORY II Temperature of incubator more constant			
Competition	No. of samples	Keeping quality		Competition	No. of samples	Keeping quality	
		Hours sweet when maximum was taken as 96 hours	Additional hours of sweetness found			Hours sweet when maximum was taken as 96 hours	Additional hours of sweetness found
1	37	3,042	48	A	8	480	0
2	63	5,268	156	B	23	1,344	0
3	16	1,326	0	C	4	240	0
4	79	6,282	114	D	31	2,301	0

milk may be known. Table I shows that a study of keeping qualities, based upon bacteriological counts alone, would lead to fallacious and unjust results. Thus a man who supplies a milk which does not contain more than 30,000 colonies per 1 c.c. and no coliform organisms is doing very useful work, which is reflected in an average keeping quality of 68 hours; this period is reduced to 59 hours in the case of those whose work is less efficient, as shown by the fact that their milk of the same count contains coliform organisms.

If, however, the results be combined, as would be the case if reliance were placed upon counts alone, an average keeping quality of 63 hours is found to obtain. The better class of work is thus penalized to the extent of five hours, and work of a less good quality gains an undeserved addition of four hours to the average keeping quality of the milk produced. Too much stress cannot be laid upon the extreme importance of such periods of time if the whole milk trade is to be conducted successfully.

(4) Of the 2,476 samples which were examined only 16 showed bacteriological counts which were above a million, and nearly half the samples did not contain B. coli.

It is the experience, of those who have studied the problem of clean milk production, that the exclusion of coliform organisms from milk is an even more difficult task than the reduction of the bacteriological counts. The results, therefore, which have been obtained reflect credit both upon the farmers and those who are trying to help them, especially when it is remembered that many of the farmers were undertaking a task of which they had little previous experience.

In Table II the influence of coliform organisms upon the keeping qualities of milk is studied in further detail. In order that this may be done the Table has been divided into five parts which bring out the influence of the presence of coliform organisms in varying dilutions upon milk of similar bacteriological counts.

A study of this table demonstrates still further the importance of the coliform test to the milk industry, since it makes it clear that the keeping quality of milk, of any specified bacteriological count, progressively deteriorates with increasing numbers of coliform organisms. It has already been pointed out that the averages cannot be accepted as final, but, as an illustration of what may be anticipated when figures in sufficient numbers have been gathered together, the keeping qualities of those samples which gave counts between 0 and 1,000 may be considered. When coliform organisms were not

found, the average keeping quality was 77 hours; this average fell steadily to 75, 67 and 66 hours as coliform organisms were found to be present in increasing numbers in the samples.

Importance of a Constant Temperature in the Study of the Keeping Qualities of Milk.—At one period of these competitions it was found that some samples showed very prolonged keeping qualities. It was not known whether these were due to some quality of the milk or to inequalities of the temperatures at which the samples were kept, as some laboratories were not in possession of incubators which could be maintained at 60° F. A final conclusion on this point can hardly be said to have been attained, but a consideration of the figures shown in Table III demonstrates that constancy of temperature is a very important factor.

This table was prepared as the result of discussions between two workers at different centres, one of whom, owing to local conditions, had great difficulty in maintaining his samples at 60° F.; the other could do so with but small variations. In both cases the figures are taken from those samples of which the bacteriological count lay between 0 and 1,000 and in which coliform organisms were not found.

These figures make it clear that the constancy of the temperature at which the samples were kept was probably an important factor in controlling the keeping qualities of the milk. This is a factor which can and should be controlled in all laboratories.

This paper is published in the hope that the Committee of Advisory Bacteriologists will continue this work by gathering together and collating the results of the different competitions over a period of years. If this is to be done successfully, there are certain facts which are not at present given which should be included in the reports:—

(1) Milk taken by hand or machine.
(2) Whether or not steam sterilization is adopted on the farm.
(3) The temperature to which the milk is cooled and its temperature at the time of examination.
(4) The age of the milk at the time of examination.

OUR IMPROVED MILK SUPPLY*

J. F. BLACKSHAW,

Dairy Commissioner, Ministry of Agriculture and Fisheries.

THE Medical Research Council recently published a report in which Dr. Corry Mann sets out the results of an experiment which he conducted on "Diets for Boys during the School Age." It is not proposed to dwell on this experiment, but one may venture to draw attention to it because the results demonstrate most conclusively the beneficial effect of the addition of milk to the usual diet. In illustration may be quoted the following passage from the preface :—

> It is startling to learn, as we now do, for instance, that the addition of one pint of milk a day to a diet which, by itself, satisfied the appetite of growing boys fed upon it could convert an average annual gain of weight of 3·85 lb. per boy into one of 6·98 lb., and an average increase in height from 1·84 in. to 2·63 in.

Had an excuse been needed for bringing to notice the subject of our milk supply, then surely the passage quoted provides by itself sufficient justification. The question, however, gains further significance when we consider our average behaviour in this connexion and contrast what is happening here with what takes place in some other countries. It is computed that our average consumption of milk per person per day is approximately one-third of a pint, whereas several other countries—Canada, the United States of America, Denmark, and Sweden—claim to consume correspondingly one and one-third pints per day. Can we as a nation—competing with other nations—afford to neglect to take advantage of the one food above all others which acts so wonderfully in building up and maintaining physique, constitution, and mental alertness ?

Vitamins.—We have still much to learn about milk, but we are getting to know more, and each addition to our knowledge causes a more profound appreciation of the marvellous skill and foresight exercised by Nature in arranging its constitution. For instance, it is only during the last few years that we have learned to appreciate the fact that milk, in addition to being the most perfectly balanced of foods, contains vitamins of the utmost importance to the proper functioning of each constituent of milk in its work of body

* This article is substantially the text of a recent broadcast address by Mr. Blackshaw.

building and maintenance. Research respecting these vitamins is engaging the attention of many workers. Already important information has accumulated, but there is still much more to be discovered. We know enough, however, to be justified in saying that these vitamins are not alone concerned with the proper digestion of the milk which contains them, but in addition play an important part in the utilization of the diet as a whole. In other words, they are of general aid to the digestion. We also know that for the most part they are unstable bodies readily susceptible to injury, which may render them partially or entirely inert. For instance, on some of them heat has a devastating effect, the moral of which is, "Don't boil milk unless you must." Another fact worth remembering is that the fresher and purer the milk the greater is the potency of these vitamins.

Milk a Delicate Article.—There is one more important matter to which attention should be directed, and that is the extreme delicacy of milk. Being such a highly organized food, milk is an excellent medium for the growth of bacteria, and it follows that contamination readily takes place, unless extreme care in handling is exercised. Consequently, a very necessary precaution is extreme cleanliness. To appreciate the true and inner meaning of cleanliness in its application to milk it is almost necessary to possess at least a rudimentary knowledge of bacteriology. For instance, in the cleaning of utensils intended for use as milk containers—be they milk churns, cans, or the householder's jug—it is not sufficient to remove only the visible dirt, for if one would reduce contamination to a minimum, and thus delay souring and other risks, one must also take steps to remove the invisible germ life which still clings to the inner surfaces after the ordinary methods of washing away visible dirt have been employed. Repeated experiments have shown that ordinary methods of washing, even with the hottest water usable, do not render the vessels clean in the bacteriological sense. Indeed, it has been convincingly proved that of the means available nothing short of steaming for several minutes will render such vessels bacteriologically clean. This fact is becoming more and more appreciated by producers and distributors of milk, and the use of steam, both on the farm and in distributing depots, is daily becoming more general. One would like to feel that the average housewife were equally appreciative.

Our Milk Supply.—As regards our milk supply, the writer desires to say, after ample opportunities of judging, that, notwithstanding the uncomplimentary references to milk that we often read in the Press, and notwithstanding the many improvements which are still needed, he is personally of the opinion that the British public is to-day being supplied with milk which on the average is second to that of no other country, and at a price which renders it one of the cheapest, if not the cheapest, food on the market.

We have still some considerable way to go, however, before we arrive at an all-round perfect milk supply, but if we can only maintain the rate of progress which has been effected by producers and distributors during the last four or five years, we shall before long have reason to be proud of our accomplishments.

Education and Research.—As to the means by which progress has been speeded up during recent years, it should be remembered that each individual household can play a part—a useful part—in helping forward future progress. In this matter, as in most others, it is now generally agreed that the key to progress is education and research, and therefore during the last few years much greater attention has been paid to providing means whereby producers of milk, distributors of milk, and administrators of milk regulations can acquire information both in regard to the nature and constitution of milk, and of the circumstances that matter, as well as the reason why they do matter, in its production and handling.

To this end a National Institute for Research in Dairying was established at Reading some 14 years ago to inquire into the precise circumstances which affect efficiency both in the production and distribution of milk, as well as all other matters concerned with milk products. This institute has been remarkably successful in this work, with the result that it has now grown into an undertaking of considerable dimensions. More recently agricultural education committees and sub-committees of county education authorities have been stimulated to provide additional teaching in all phases of dairying, with special attention to the production and handling of milk. The result of this has been that almost every county education authority has set up a staff of instructors, qualified both practically and scientifically to impart information to those who are engaged within their respective areas in the producing and handling of milk. The provision of both the research institute and the county staffs has been made

possible by liberal grants in aid from the State, administered through the Ministry of Agriculture and Fisheries.

Clean Milk Competitions.—The extent of the educational work that is going on in the country may be roughly judged by the fact that in this connexion 72 specialist dairy instructors are constantly at work. The methods by which the instruction is conveyed to those concerned are several, but space does not permit of details. Some of the main features, however, may be referred to. One of the most successful methods has been the organizing of county clean milk competitions. These competitions are conducted on a definitely educational basis; indeed, the whole purpose of their provision is the creàtion of a channel by which there can be conveyed a real understanding of the circumstances that matter in clean milk production. It is not going too far to say that it is impossible to take part in a competition without the operators concerned gaining an intelligent appreciation of the reasons why the practising of certain methods is essential if clean milk is to be produced. These competitions have become very popular amongst the agricultural community; so much so that during the past year there have been 34 county competitions with 843 competitors taking part, owning amongst them over 20,000 cows, and arrangements have now been made for the conduct during 1927 of 41 such county undertakings.

Clean Milk Demonstrations.—Another feature is the holding of clean milk demonstrations, involving visits by the instructor to cowsheds wherein the preparation of cows for milking, the milking, and general handling of the milk are demonstrated as they should be practised. This is done in the presence of an audience of interested people who, during the process, are encouraged to question and generally seek the solution of problems in which they may be interested. During this past year such demonstrations have been attended by upwards of 17,000 people.

Classes for Milkers.—Still another feature is classes for milkers, which usually conclude in a skilled competition. Such classes are held for the purpose of securing skilled manipulation and the practice of hygienic methods. Other activities embrace the delivery of both pioneer and class lectures on technical matters concerned with dairying. In addition, regular courses of instruction are held at our agricultural colleges and farm institutes for those who are able to devote sufficient time to undertake systematic study.

A very satisfactory feature connected with this work is the changed spirit which has come about amongst those concerned with the milk industry. There was a time when the dairy farmers were sceptical as to the value of such instruction, but to-day, generally speaking, they are exhibiting a most receptive mind. Indeed, it is only fair to say that they are really anxious to improve their methods, both in their own interests and with the object of rendering better service to the community.

Public Appreciation.—This leads one to refer to a matter which is bound to have an influence on maintaining the enthusiasm of producers, namely, the appreciation which ought to be shown to them by the public. As matters stand to-day the education of the milk producer in things concerning clean milk has proceeded at a more rapid rate than has that of the consumer. The production of milk of the highest hygienic quality requires a good deal of extra care in regard to the methods practised, and sometimes also of expenses in regard to structural accommodation, though it is true to say that it is methods that count more than buildings. Extra care and structural alterations involve additional cost in production, and men who have taken the trouble and have incurred the cost of producing better milk not infrequently find that consumers fail to support them by being prepared to pay even a fractional increase in price. It follows, therefore, that the progressive producer quite often meets with discouragement, and he is apt to say, not always without justification: "What is the use of my taking this extra trouble, and incurring this additional cost, when my neighbour, who has done none of these things, is able to sell his milk as well as I can?" If, therefore, consumers really desire to encourage this better milk movement, they must show a preference and even be prepared to pay slightly more than is their usual custom. Good milk, that is to say, milk that is clean and will keep, is always cheap, whereas dirty milk is always dear.

As milk is such an efficient article of diet, and being as it is one of the cheapest foods on the market, one may well ask whether consumers are making the fullest use of it. The other countries named above use milk and its products in a greater variety of ways than is the practice in Great Britain. Further, irregular demands have an effect on the margin of cost that the distributor must take to cover his losses on surplus supplies of this highly perishable food.

TIMBER COTTAGES FOR RURAL DISTRICTS

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THE housing of the agricultural labourer was, even before the violent disturbance of values which the War produced, a matter of financial difficulty. Effort was then concentrated on the design of a type of dwelling which should provide a living-room, scullery, and three bedrooms, with larder, fuel store, and conveniences, for an inclusive sum ranging from £120 to £150, and many will remember the competition and exhibition held in connexion with the inauguration of the First Garden City at Letchworth, where cottages of all descriptions with a price limit of £150 were shown.

Since building prices, after a period of staggering fluctuation, have apparently stabilized at a level roughly double pre-war standards, the problem is even more difficult—particularly in situations remote from neighbouring towns, where the added trouble of unwilling venture on the part of building labour is felt.

While such authorities as the London County Council and Cardiff Corporation have considered and experimented with timber houses, there yet lingers a strong feeling in the much more suitable rural districts that such dwellings are necessarily inferior and unworthy. There is, of course, ground for this feeling, but it is almost certainly based on such unfavourable instances as the many amateur-built timber shacks and reconstructed army-huts which have been from the first almost uninhabitable, and have rapidly deteriorated in use until ultimate total dilapidation threatens or ends them.

There are, of course, very many timber houses and cottages in existence in this country which, after some hundred years of useful life, are still sound, warm, and comfortable; and in this class it is not necessary to include the oak "half-timber" structures of much older origin, but to urge solely the claims of the type of structure weather-boarded externally over a framework of fir-timber.

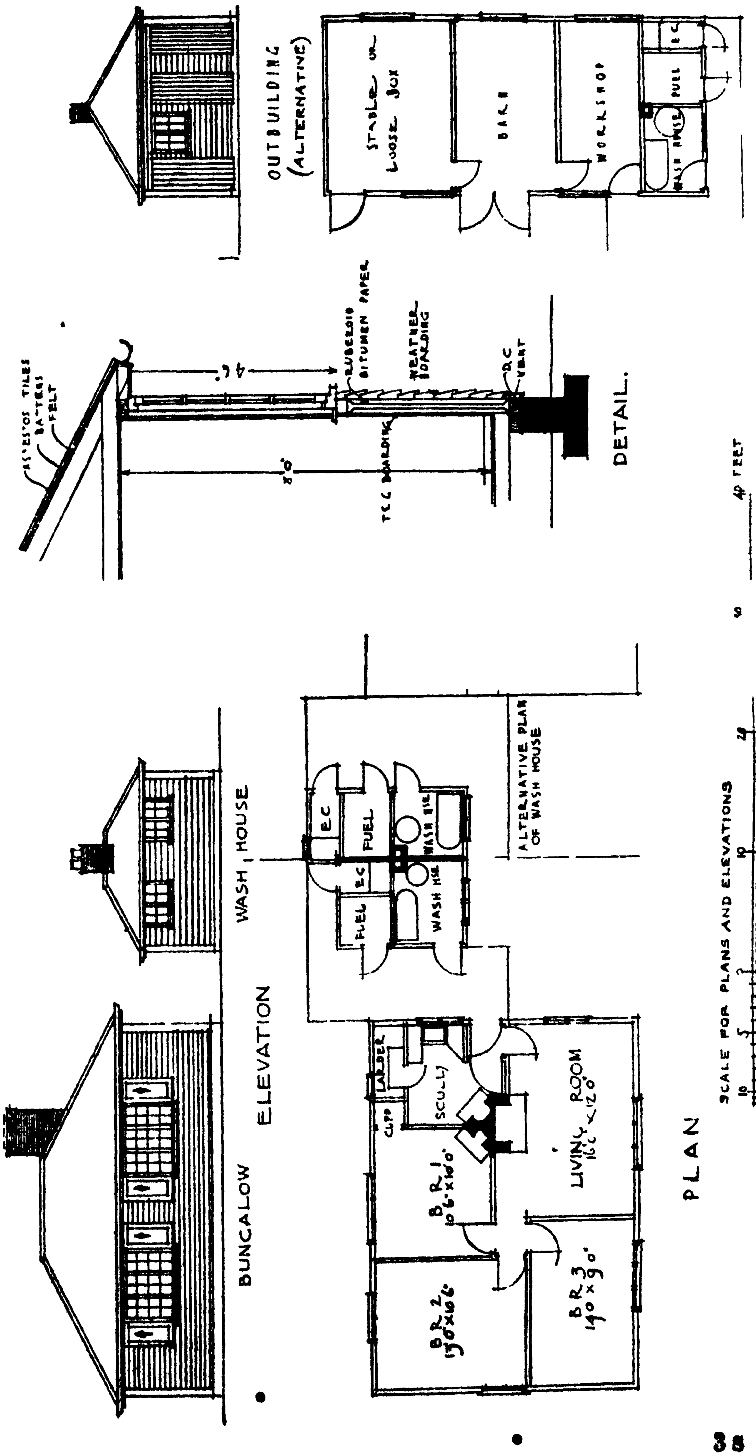
Recent scientific tests of the thermal conductivity of various materials place timber high as a non-conductor in relation to dense materials such as brick or concrete, and the experience of cold countries has always inclined to prefer it for warmth and dryness. There are, moreover, modern materials now available which permit easy avoidance of some of the possible

defects of timber houses. These may be briefly enumerated as (1) liability to decay of ground-cill and feet of uprights; (2) draughts and occasional penetration of wind-driven rain through shrinkages or knotholes.

To avoid liability to decay, it is the first essential that the ground-cill and sheathing shall be mounted well above the ground surface so as to avoid continual saturation by splashing from heavy rains, and from the sheltering growth of plants and herbage. Experience determines the necessary degree of elevation as 18 in. above ground, and a base of brick or concrete to this height is always advisable. All timber used in framings (and not solely timber exposed to the weather as often specified) should be liberally served with creosote or one of its preparations. With these precautions taken there is no reason why a soundly constructed timber house should not outlast many of the slightly built brick and concrete structures which are now going up. A framed structure has strength within itself to resist disruption from slight foundation settlements.

Draughts and penetration of rain are now countered by interlining external walls with bitumenized paper or felt under the external weather-boards; and similar material applied with or without wire-netting immediately on the rafters before tiling will greatly increase the comfort and weatherproof qualities of the roof. For general economy of construction a relatively light form of roof-covering is advisable, and in this category slates, interlocking tiles, asbestos-cement pantiles, or the common diagonal asbestos slates may be classed. If the latter are chosen the natural grey colour is greatly to be preferred to so-called red, which is actually a wishy-washy shrimp-pink certainly not worth extra payment—however slight. "Rustic" or rust-stained asbestos material is another thing, and if this type of roof is used in a tile district is the least offensive that can be chosen. In a slate or thatch district grey is to be preferred, and with such material a red ridge or hip tile should be avoided. Blue, buff, or dun-colour would be unobtrusive.

With some consideration given to the proportion and spacing of the windows, and a less starved treatment of the eaves than is usual in hut bungalows, there is no reason why a timber house should be a blot on the landscape. The Ministry has now proved, from observation of several examples built in exposed positions on Salisbury Plain, that timber dwellings, constructed on the lines described, are convenient and comfortable. The earliest have now been inhabited for two years,



Anfinset Timber Bungalows for Cottage Holdings, with alternative plan for wash-house and alternative outbuilding including wash-house. Messrs. Henry Tanner, Architects.

and have given no trouble which could be related to their type of structure. These examples were built by local builders at costs between £330 and £360, gravel for concrete foundation walls being obtained free on the estate.

The Ministry's plan has now been adapted to mass-production methods by Messrs. Henry Tanner, acting as architects for a firm of timber-house builders who have added it to their standard types and are prepared to construct bungalows and outbuildings extended as shown in the illustration, to furnish equipment ample for a cottage holding, for about £450.

THE NEED FOR LAND DRAINAGE

For some time past the Ministry has been endeavouring to obtain such information as would enable it to form a fairly reliable estimate of the amount of agricultural land in England and Wales which is suffering from lack of drainage. Valuable information on the subject has been obtained from County Councils. Areas in need of drainage are not, however, always contained within the limits of one county, and many watersheds are spread over several counties. For this and other reasons the information obtained from this source has, in many cases, proved incomplete, but the Ministry has been able to supplement it by records compiled from returns furnished by drainage authorities, from reports furnished by its inspectors and crop reporters, and also from the experience gained as the result of drainage operations, carried out during the past five years for the relief of unemployment.

The result shows that the land in need of drainage can be placed in two categories, *viz.*, (*A*) land which is urgently in need of drainage by reason of flooding occasioned by defective or obstructed arterial channels, and (*B*) land which is capable of improvement, by means of small drainage schemes for the clearance of main ditches and other small water-courses. A summary of the position is set out below, and, in compiling this statement, no account has been taken of individual fields or groups of fields which could be improved merely by some form of field or under-drainage.

	Urgently in need of drainage (Category *A*) (acres)	Capable of improvement (Category *B*) (acres)
TOTALS	1,279,350	475,850
GRAND TOTAL	1,755,200	

Northern Counties.—In the northern counties there are many thousands of acres of land suffering from lack of drainage, and, although many attempts have been made to establish drainage boards for various districts, these efforts have met with little success. In Cumberland no extensive scheme of land drainage is necessary, but the improvement and maintenance of a number of drains and small rivers would be of great benefit to thousands of acres of land. In this county, as well as in Northumberland and Durham, there are large areas of sheep-grazing lands which could be improved by means of ditching and under-drainage, but this large acreage is not taken into account for present purposes. In Durham there are numbers of separate small areas, amounting in the aggregate to some thousands of acres, damaged by mining subsidence and consequent flooding.

The Lancashire County Council has taken special drainage powers by means of its Drainage Act of 1921, and these powers, of which the Council is apparently taking every advantage, are sufficient to enable it to deal with such cases of defective drainage as are normally capable of improvement under existing drainage legislation.

The West Riding of Yorkshire County Council has also acquired powers under its special Drainage Act of 1923, and is taking steps to deal with the problems of land drainage in that county, these, however, being complicated by the fact that so much of the land is subject to mining subsidence. A Special Commission is, however, now looking into this matter.

Midlands.—There is a considerable area of land in the Midlands which is in need of improvement, and in Staffordshire a large scheme of drainage is required to deal satisfactorily with the condition of the Trent Valley, the Tame, and the Blythe. It is true that a considerable amount of useful work has been done by means of unemployment relief schemes in the area of the Avon and Trent Valley in Warwickshire, but the improvement effected needs maintaining, while further work could be usefully carried out in this area. In the remaining midland counties there are a number of separate areas, small in themselves, which could be considerably benefited by drainage works.

South Midlands.—Again, the condition of much of the agricultural land in the southern midlands calls for vast improvement. The valleys of the Thame, Evenlode, Wind-

rush, Gay, and Cherwell are in an extremely bad state. The upper reaches of the Great Ouse and Thames both present drainage problems, the sole solution of which lies in the carrying out of extensive works of improvement, while there are many scattered areas in Berkshire which could be considerably improved from a land drainage point of view.

Southern Counties.—Some 40,000 acres of land in Kent and East Sussex are liable to flooding, and, although considerable improvement has been effected by works carried out by the Kent and Sussex Rother Levels Commissioners at Rye Harbour mouth with the assistance of a grant from the Ministry, much further work of improvement is necessary if permanent benefit is to be conferred on this area. Hampshire and West Sussex have several drainage problems to tackle. The latter county is dealing with the River Arun outfall by means of a private Bill, to be introduced in 1927.

The County Council of Middlesex has special statutory powers with respect to land drainage which are unique in that the whole county can be rated regardless of benefit, and is enabled to deal with this subject as with any other county service, with excellent results. It is only on the county boundaries where rivers are not wholly within that county that difficulties arise.

The Surrey County Council also has recently obtained special powers which enable the Council to deal with all small watercourses, but the need for works of land drainage in the Wey Valley and the headwaters of the Medway is apparent.

Eastern Counties.—In the eastern counties a considerable amount of land could be benefited by effective drainage works. In East Suffolk there are approximately 11,350 acres which could be improved; whilst in both East and West Suffolk works of drainage, which have been carried out under the Ministry's unemployment relief programmes, require to be maintained.

Drainage work is also needed in connexion with many areas in Essex, Norfolk, and Lincolnshire.

West of England.—As far as the western counties are concerned, there are in Dorset, apart from the Stour Valley, approximately 5,000 acres capable of improvement, while Gloucestershire also has large scattered areas in the lower Avon and Severn Estuary which could be benefited. In the

last mentioned county much useful work on lesser streams has been accomplished under the Ministry's unemployment relief programmes, but here again the improvement effected thereby requires to be maintained.

In Wiltshire it is estimated that 135,000 acres of land are in need of drainage operations, and there are approximately 54 miles of derelict canals which also need attention. Here again a large amount of useful work which has been done by means of unemployment relief schemes requires maintenance.

Low-lying land in Somerset is entirely under the jurisdiction of drainage authorities, with satisfactory results, but there are many small areas capable of improvement in Devon and Cornwall.

Wales.—In Wales there are numerous areas near the coast, mainly in the counties of Carnarvon, Pembroke, Glamorgan, Carmarthen, Merioneth, and Cardigan, where a substantial acreage, estimated at 120,000 acres, could be brought into good cultivation, or at any rate be considerably improved, by efficient drainage.

General.—It will be evident from the brief survey above that a vast amount of work requires to be done if valuable land in large tracts is in many cases to be saved from sooner or later becoming completely derelict. That such is the case requires no expert eye, but merely the casual observation of any ordinary traveller from one end of England to the other. The stumbling block, however, is the cost, and it is difficult to see how this obstacle can be effectively overcome short of a wholesale abandonment of the restrictions at present imposed by existing legislation. Whether the present state of affairs can be remedied in this respect remains to be seen.

It must not be assumed, however, that even the present law does not afford opportunity for beneficial work on a minor scale to be done in a great number of instances. Under the Land Drainage Act, 1926, the powers conferred upon County and County Borough Councils should enable those of them who are prepared to deal with the question of land drainage as one of urgency to effect considerable improvement. Not only are those Councils empowered to carry out small schemes in areas where no statutory drainage authority exists, but they can compel the removal of obstructions which, although slight in themselves, are liable to cause widespread flooding if they are not speedily removed.

The Ministry is not unmindful of the difficult times through which agriculture is now passing, but in cases of the kind last mentioned above there can be no question that the expenditure involved is not only essential, but will ultimately prove profitable.

NOTES ON WEEDS

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IT is thought that the following notes on some weeds prevalent in the south-western counties may be of interest to readers of this JOURNAL.

Wild Mignonette or Dyer's Rocket (*Reseda Luteola* L.).—This weed has appeared on several farms in the upper Teign Valley (Devon) within the last two years. In every case the presence of the weed followed the sowing of a seeds mixture. It is rarely met with as a weed in these parts and has obviously been introduced. Its presence strongly suggests the Continent as the original home of some of the ingredients of the mixture, since other cases have occurred where the ultimate source of the seeds was definitely established.

Hoary Pepperwort (*Lepidium Draba* L.).—Two or three years ago this weed suddenly appeared as a dense "colony" along the wall of a new building erected in Newton Abbot. Since the weed is only found occasionally in the south-west, and since the huge quantity occurring around the building made it evident that it must have been introduced in some quantity, the case was investigated. After careful inquiry, it was finally discovered that machinery had been imported from France and that it was packed in grass and straw. Unfortunately, it was too late to obtain any of the material of the packing, but there is little doubt about the origin of the seed, for there are no records of the plant occurring in the district, and fortunately, so far, no spread of the weed.

Dogs or Perennial Mercury (*Mercurialis perennis* L.).—This plant, which is normally most common in hedges and shady woods, occasionally wanders into fields which are shaded by tall trees. In most cases stock do not eat the plant, or, if so, sparingly. During the early spring, when "keep" is not too

plentiful and pastures are rather bare, there is always the danger that early growth of any kind will be devoured, especially by young stock. Three years ago a farmer lost seven young bullocks owing to the fact that during a rather "bare" spring they had eaten considerable quantities of this plant which was growing near a stream and shaded by trees.

A curious point was that those which were ailing died even after removal to other pasture. The poison affected the eyes, which became rather sunk in the head, the body "bunched" and the excreta black, rather dry and hard. Some of the animals died in a very short time, while others lingered on for almost two weeks.

Hemlock (*Conium maculatum* L.).—Although cases of poisoning by this plant are not rare, it is not a common occurrence for poultry and ducks in particular to suffer by eating the "seeds." In the autumn of 1925 we examined the crops of several ducks which died rather suddenly. In every case there was a plentiful supply of hemlock seeds with fragments of the fruit and fragments of stem. Cases of this kind occurred in several parts of Devonshire and were not restricted to one or two districts. Such periodic outbreaks rather suggest that the proportion of the poison to other material reaches a dangerous or high figure only under certain seasonal conditions.

Brooklime (*Veronica Beccabunga* L.).—So far there seems no record of this plant being either poisonous or causing any trouble if eaten by stock. Last spring specimens were brought for identification as the plant had been affecting stock, the digestive tract in particular. A ditch ran through the field where there was a large quantity of brooklime, but no other plant beyond the grasses common to a pasture. It would be interesting to know if any further cases of this nature have been recorded.

Broom-rape (*Orobranche* spp.).—In 1926 there was a very marked increase in broom-rape in the south-western counties. In 1925 a few cases were noted, one in particular in a clover field which it was intended to lay up for seed, while in the past year quite a number of hayfields were affected. A very noticeable feature is that in most cases the parasite is not present in small restricted patches, but is scattered fairly evenly throughout the field. In two fields on one particular farm examined, the broom-rape appeared in lines where the grass and clover seed had been sown. Similar indications were found elsewhere, though less pronounced. In the first case

mentioned, the clover and grass seeds had been carefully cleaned, and certified by the Seed-Testing Station at Cambridge, so that no blame could be attached to the seeds firm. In the case of the two fields, however, broom-rape had never been seen previously on the farm, and, taking all the facts into consideration, it seems obvious that it was introduced with the seed. There is a widespread belief that broom-rape is not introduced with seed, but occurs in the soil and appears suddenly at long intervals when the season happens to be particularly favourable to it. That certain seasons do favour particular plants is a well-known fact, but if this was the sole reason of the increase in broom-rape, it might be expected to appear as a series of irregular patches and not a definite and regular distribution throughout a field or part of a field. Again, most farmers are not so unobservant as to fail to notice the presence of such a weed when it occurs in any quantity. (See also note at p. 981.)

Corn Sow Thistle (*Sonchus arvensis* L.).—This is a well-known weed of many districts, but there has been in recent years a very marked increase in the quantity of the weed on many farms. Another disquieting feature is that it has appeared on several farms and in districts where it did not occur previously. This is true of Scotland as well as England. During the last five years there have been quite a number of cases where the plant appeared for the first time and has steadily increased. A noticeable feature is that it usually appears first with a cereal crop, either oats or barley, especially the former. It is, however, not confined entirely to such crops, for several bad cases have been observed in hayfields. Last summer the writer visited one farm where the hay crop had failed (not surprising) and where a veritable forest of corn sow thistle represented the hay, the general state of the field being disgraceful.

Field or Creeping Thistle (*Cirsium arvense*).—This plant is of wide distribution and well known to all. A most noticeable feature this year, however, has been its presence in dense masses over wide areas in fields, utterly excluding the crop. As is the case with the corn sow thistle it was worst in oats and to a lesser extent in barley. Several fields have been observed in the southern counties of England where it was no exaggeration to place the proportion of thistles to crop at 25 per cent. In practically every case the plants had reached the fruiting stage.

Ragwort (*Senecio Jacobea* L.).—This weed has made too much progress during the last few years. In several districts, especially where the grazing is light and where the number of stock has been reduced, it threatens to overrun the pastures of some farms. Doubtless the absence of sheep has contributed in some cases to this increase, but cutting will keep it in check if done regularly. In one case a field was so bad that it had been sprayed with copper sulphate solution (5 per cent.) with fair success.

Bog Myrtle (*Myrica Gale* L.).—A case of poisoning of stock by this plant has recently been recorded in the North of England. The material found in the alimentary canal was woody tissue of the plant. This is both an interesting " first record " and a curious case, since the plant is quite common in many grazing areas in Scotland, and so far as the writer is aware this is the only case recorded of stock being affected in any way.

FURTHER EXPERIMENTS ON THE CONTROL OF AMERICAN GOOSEBERRY MILDEW

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THE promising results obtained from the spraying experiments carried out in the Bristol Province in 1925* made it appear desirable to continue similar trials on the same lines in 1926. In the 1925 experiments, the advantage that accrued from an early application of the spray fluid, before any sign of the mildew was visible, was shown. The most suitable time for this application is considered to be immediately after the setting of the flowers. In warm sheltered plantations there seems to be no reason why the initial spraying should not be given earlier still, as spraying does not appear to affect the setting of the flowers. The effect of this early spraying is to check the spread of mildew arising from minute infection-centres set up by the winter fruiting bodies of the fungus which, lying on or near the surface of the ground or situated on the old mildewed twigs, are in the act of producing innumerable spores.

It was suggested by these experiments that Burgundy mixture, owing to its well-known fungicidal properties and

* JOURNAL OF MINISTRY OF AGRICULTURE, Vol. 33, June, 1926, and Report of Long Ashton Research Station, 1925.

adhesive nature, might be an efficient preventive if applied, once only, at a sufficiently early stage. Since most growers are naturally averse from spraying their bushes twice, it was decided to test the relative merits of one application of Burgundy mixture against one and two applications of ammonium polysulphide, a fungicide of proved efficacy against American gooseberry mildew, and, simultaneously, to ascertain the value of a second application of ammonium polysulphide.

An account of this trial is given below in Section A. Section B deals with a repetition of the 1925 trials, the main object of which was to test further the efficacy of the washing soda and soft soap spray fluid.

SECTION A TRIALS

The Plots.—The plots consisted of well-grown Whinham's Industry bushes in a series of double rows, each series being 25 feet apart and containing 48 bushes.* Seven of these series were taken for the experiment. The control plot consisted of the eight central bushes in each series, forming a strip running through the centre of the plot, thus allowing for any variation in intensity of attack which might occur in different portions of the plot.

Sprays.—The two following spray fluids were used :—

A.—Ammonium polysulphide and soft soap :	
Ammonium polysulphide	½ gall.
Soft soap	5 lb.
Water to make up to	100 gall.
B.—Burgundy mixture :	
Copper sulphate	8 lb.
Washing soda	20 lb.
Water to make up to	100 gall.

Application.—In the application of these sprays, two of the series were sprayed with Burgundy mixture, three with ammonium polysulphide once, and two with ammonium polysulphide twice. The first application in all cases was given on April 22—immediately after the setting of the flowers. At this time no mildew was visible on any of the bushes. The machine used was a hand-pumped "Rapid" sprayer, working at a pressure of 60 lb. The bushes were given a thorough spraying, special care being taken to wet

* For a detailed account of this plot see writer's article in this JOURNAL, June, 1926, p. 266.

the central portion of the bushes and the under sides of the leaves thoroughly. To ensure uniformity the whole of the spraying was done personally by the writer.

No damage was observed on any of the bushes sprayed with ammonium polysulphide ; but after about ten days the leaves of the bushes sprayed with Burgundy mixture showed a certain amount of spotting, and this was followed later by an entirely negligible amount of leaf drop. The set and ripening of the fruit were in no way affected. The plots receiving two applications of ammonium polysulphide were again sprayed on May 18. By this time a considerable amount of new growth had been produced, and although a certain amount of mildew was present on the control bushes, none was observed on the sprayed bushes.

Results.—The fruit was picked on June 21, and was sorted into clean and mildewed berries and then weighed. The following table gives the weight of clean and mildewed berries from each plot :—

SECTION A TRIALS

Spray fluid used	No. of times applied	Date 1926	Crop Weight in lb. Clean	Crop Weight in lb. Mildewed	Weight of mildewed berries per cent.
Ammonium polysulphide	Once	April 22	456	84	15·5
Ammonium polysulphide	Twice	April 22 & May 18	502	30	5·6
Burgundy mixture ..	Once	April 22	482	22	4·3
Control ..	—	—	143½	95½	39·9

In considering the above figures, it must be borne in mind that there was a greater number of berries in a given weight of mildewed fruit from the control plot than in a given weight of mildewed fruit from a sprayed plot, and, owing to inhibited growth, the average size of the berries was much smaller. Sorting was done by labourers in the same way as when dealing with a commercial sample. The crop was tipped on to a sloping sorting board and the mildewed berries removed from the bulk. No differentiation was made between slightly and completely mildewed berries.

It will be seen that one early spraying with ammonium polysulphide gave a considerable degree of control, the once

sprayed plots having 15·5 per cent. of the crop mildewed as against 39·9 per cent. of the control plots. A second spraying 26 days later gave a further reduction of approximately 10 per cent. of mildewed fruit. The grower himself must decide whether this further reduction will warrant the cost of a second application of spray fluid. It must be further noted that, not only does this second application give a more complete control as regards fruit, but it also very considerably checks the development of mildew on the young sappy growths of new wood which, if left to over-winter, are a potential source of danger in the following season.

The plots sprayed once with Burgundy mixture gave only 4·3 per cent. of mildewed berries by weight—in this particular trial a degree of control at least as great as that obtained by two applications of ammonium polysulphide. The efficacy is doubtless due to the good spreading power of the fluid and to the lasting character of the deposit on wood and foliage. This deposit was plainly discernible up to the time of picking the crop, in spite of heavy rain from time to time. Such a film of deposit would have the effect of inhibiting the germination of spores for a prolonged period. Its value lies more in its power of forming a toxic preventive film than in its use as a " hitting " spray; for the latter purpose a wetting spray containing soap is to be preferred. Burgundy mixture, however, must not be applied later than the setting of the flowers, for experiments in 1925 showed that not only does it fail to check the disease when once a hold is obtained by the mildew, but also the deposit left on the fruit renders it quite unsaleable.

Further experiments are needed to show whether the high efficiency of the Burgundy mixture can be maintained and at the same time its strength reduced to avoid all leaf damage. Should weather conditions be exceptionally favourable to the disease, or the bushes be especially strong-growing and environment render them very susceptible, a further application of a " hitting " spray fluid containing soap is to be recommended.

SECTION B TRIALS

The Plot.—A further series of spraying trials was carried out at another centre. In this case the plot consisted of six parallel rows each containing 150 bushes of Whinham's Industry, four years old. One end of the plot was overshadowed by some tall elm trees, and, as would be expected, it was here that the heaviest attack of the mildew occurred. The plot

was divided up into 12 smaller blocks of approximately equal sizes. These smaller blocks received the spray fluids in the following order :—

No. of Blocks		
(1), (5), (9)	..	Ammonium polysulphide and soft soap.
(2), (6), (10)	..	Proprietary soda sulphur.
(3), (7), (11)	..	Washing soda and soft soap.
(4), (8), (12)	..	Control. No spray.

Spray Fluids.—The following spray fluids were used :—

(1)	Ammonium polysulphide	½ gall.
	Soft soap	6 lb.*
	Water to make up to	100 gall.
(2)	Proprietary soda sulphur compound	10 pints.
	Soft soap	6 lb.*
	Water to make up to	100 gall.
(3)	Washing soda	18 lb.
	Soft soap	10 lb.
	Water to make up to	100 gall.

Application.—All three spray fluids were applied at the same time. The first application was given on April 22; a certain amount of mildew was then visible on young growth in the vicinity of the elm trees. The second application was given on May 18, by which time a considerable amount of mildew was present on the control bushes and a small amount on the sprayed bushes under the elms.

Results.—The fruit from the plots was picked on June 21, and the crop was treated in the same way as that from the experiment described in Section A Trials. The fruit from each of the same series was mixed in order to obviate as far as possible the inequalities of the plot. The following table shows the weights of clean and mildewed berries from each of the series :—

SECTION B TRIALS

Spray fluid used	Dates of application 1926	CROP Weight in lb.		Weight of mildewed berries per cent.
		Clean	Mildewed	
Ammonium polysulphide	April 22and May 18	169	33	16·3
Proprietary soda sulphur	ditto	122	20	14·0
Soda and soap ..	ditto	95	41	30·1
Control. No spray ..	—	66	98	53·7

* 5 lb. per 100 gall. is the usual amount of soap used in these formulae -an extra lb. was added owing to the excessive hardness of the water.

Remarks.—The degree of control obtained in this experiment is poor throughout when compared with that obtained in Section A experiment. This may be accounted for by the fact that the situation of the plot was exceptionally favourable for an attack by the disease. The effect of the elms was not only to "draw up" the bushes into young sappy growth but, also, the shading and sheltering from wind favoured the dissemination and germination of spores. On the series receiving no spray, more than half of the crop was destroyed. The maximum degree of control was obtained by the sulphur and soap spray fluids, and it is with this that the efficacy of the soap and soda fluid should be compared. As heavy showers of rain were experienced after the last application, the value of these fluids was much impaired. This was particularly the case with the soap and soda fluid, which appears to act mainly as a "hitting" spray, *i.e.*, the powdery stage of the mildew is killed on coming into contact with the fluid. The soda and soap is undoubtedly toxic to mildew, but it must be applied as often as weather conditions render its application necessary. No hard-and-fast rules can be laid down.

POISONOUS PLANTS ON THE FARM—III

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Nightshade Family (*Solanaceae*).

Deadly Nightshade or Dwale (*Atropa belladonna* L.) also known as banewort, naughty man's cherry, etc., is not so widely known as is sometimes believed, many persons attributing the name to bitter-sweet (see p. 1024). It is found in waste places, thickets, and banks, "especially in chalk and limestone soils, oftenest near ruins," according to Hooker, who says that it occurs "from Westmorland southwards; also rare and near houses in Forfar, Argyle, and Ireland." The writer has found it on the coast of Fife. It is a perennial branched herbaceous plant, which grows from 2 ft. to 5 ft. high. The leaves are large, oval, and pointed, up to 8 in. long, downy, and "usually in unequal pairs." The flowers, which appear from June to August, are bell-shaped or tubular, and about 1 in. in length, purple in colour, sometimes with a greenish tinge; they are placed singly on short stalks in the axils of the

leaves. When ripe, the berries are rather large, roundish and flattened slightly, black, two-celled, and contain many seeds. The fleshy rootstock is stout and creeping (Fig. 1).

Animals and man suffer in varying degrees from the effects of dwale poisoning, but animals are quite unlikely ever to touch the plant. The root is the most poisonous part, followed by the leaves, flowers, and stem, while the berries, though deadly enough, are the least poisonous. The large attractive berries, however, are the most likely to be eaten by children, and great care should always be exercised where this plant is known to occur. Cornevin says that it has been estimated that the root is five times more active than the berries, but it must be remembered that, as in the case of other poisonous plants, there are seasonal variations : a little before the period of flowering the root is richer in the poisonous principle than after flowering. Further, the cultivated plant has been shown to contain less of the poison than the wild form. Though domestic animals have been poisoned they rarely touch the plant. Man, says Cornevin, is very susceptible to the poison, and the cat, birds, and dogs less so, while the horse is far less subject to its action than the animals named, and the pig, goat, sheep and rabbit are but little affected by it, not being poisoned through the digestive tract even if they eat the root of the plant.

Gohier and other investigators gave 2·2 lb. of the green plant to horses without causing marked trouble, and the dose continued three days in succession did not produce more accentuated pathological symptoms. In the opinion of Hertwig the larger ruminants are more susceptible to the poison than horses, but this does not appear to be strictly correct. Children are more readily affected than adults, and an adult has eaten two or three berries without injury, and in one case the consumption of thirty berries did not cause death—but it is a risky procedure to eat a single berry, for one berry can cause symptoms of poisoning, and a child died after eating only three berries.

Drying the plant does not result in getting rid of the poison, which consists chiefly of the alkaloids hyoscyamine and scopolamine, and drugs prepared from the plant are well known and widely used in medicine.

Henbane (*Hyoscyamus niger* L.) is found in parts of Scotland, in England, and in Wales, and is common in Ireland. It occurs chiefly in waste, sandy places, frequently near old

buildings, and was found almost side by side with deadly nightshade, on the Fife coast of the Firth of Forth. It is a hairy, sticky plant (Fig. 2), annual or biennial, with a strong unpleasant odour. It grows to a height of 2 ft.; the leaves are large, somewhat toothed and oblong. The flowers are funnel-shaped, five-lobed, about an inch across, dingy yellow in colour, with violet or purple veins. They appear between June and August. The seed capsule opens by means of a lid, and contains many seeds.

The root is large and thick, and has been eaten instead of parsnips and chicory with dangerous results. The leaves and young shoots have been used as a vegetable, and children have eaten the seeds with serious effects. According to Rodet and Baillet the seeds of henbane have been used in small quantities with food stuffs to favour fattening, possibly to be explained by the fact that the narcotic property induces stupor and a tendency to repose. Twenty seeds were sufficient to cause grave results in man, though not death. Henslow says, "It is recorded that the whole of the inmates of a monastery were poisoned by using the root instead of chicory," though the results do not appear to have been fatal.

All parts of the henbane are very poisonous, and the harmful principles, the alkaloids hyoscyamine and scopolamine, as in deadly nightshade, are not destroyed either by drying or boiling. The effects resemble those due to deadly nightshade. In general, animals will not eat the plant, but Cornevin records the fact that it has caused the poisoning of cows which ate it when mixed with other fodder. Pott states that the plant imparts an unpleasant taste to the milk of cows which eat it. Owing to the general habitat of the plant, however, this occurrence must be rare. Nevertheless care should be taken to avoid the ingestion of any part of henbane, either by stock or by man.

Bitter-sweet or Woody Nightshade (*Solanum dulcamara* L.) is a common plant of woods and hedges, and, although quite different in appearance, is frequently wrongly termed deadly nightshade. It is generally well known as a trailing plant, which climbs freely over hedges, having an angular or irregular appearance and branching. The dark-green leaves are ovate and simple or trifoliolate, and clusters of small purple flowers on slender stalks spring from the stem above a leaf. The flowers at once remind one of a small potato blossom, and, like those of the potato, appear from June to September.

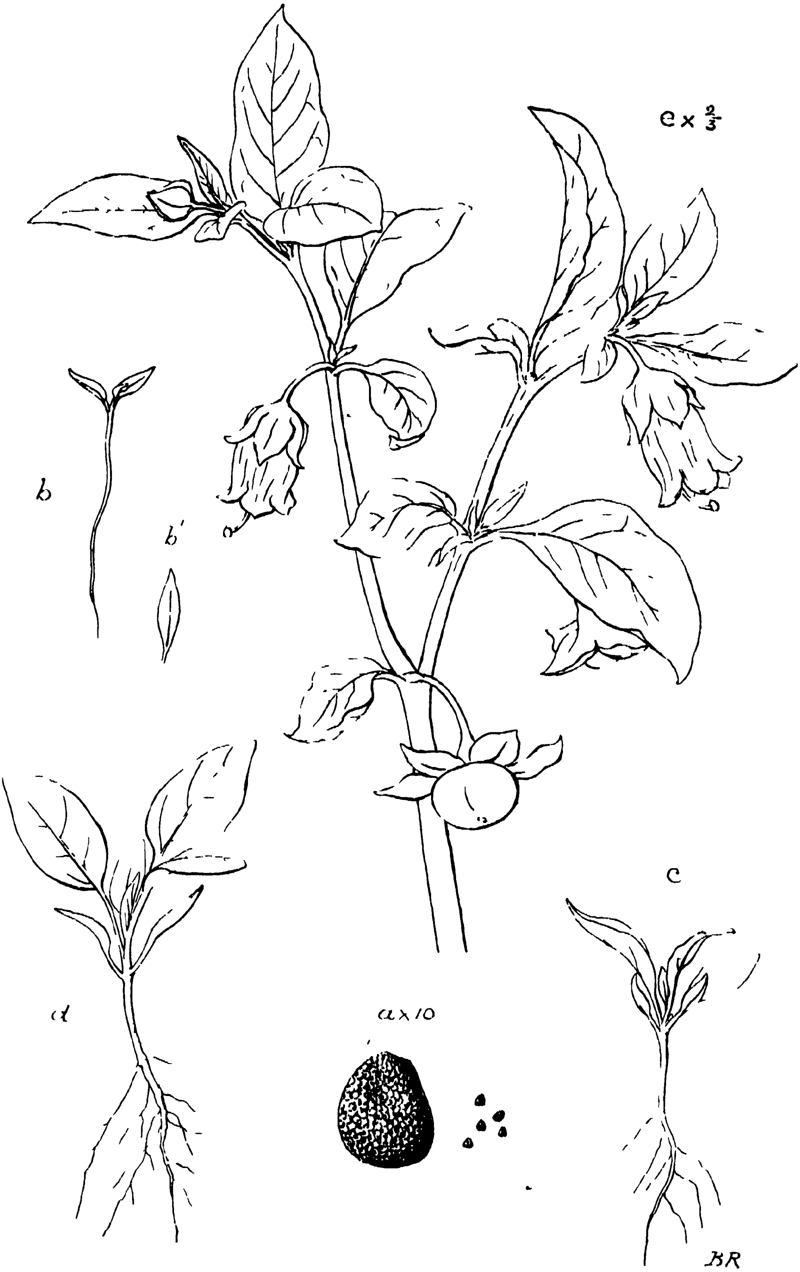

FIG. 1. Deadly Nightshade or Dwale (*Atropa belladonna* L.)

a. Seed, natural size and × 10; *b*. Seedling, first stage × 1; *b'*. Cotyledon or seed leaf × 1; *c*. Seedling, second stage × 1; *d*. Seedling, third stage × 1; *e*. Flowering and fruiting branch × 2/3.

To face p. 1024

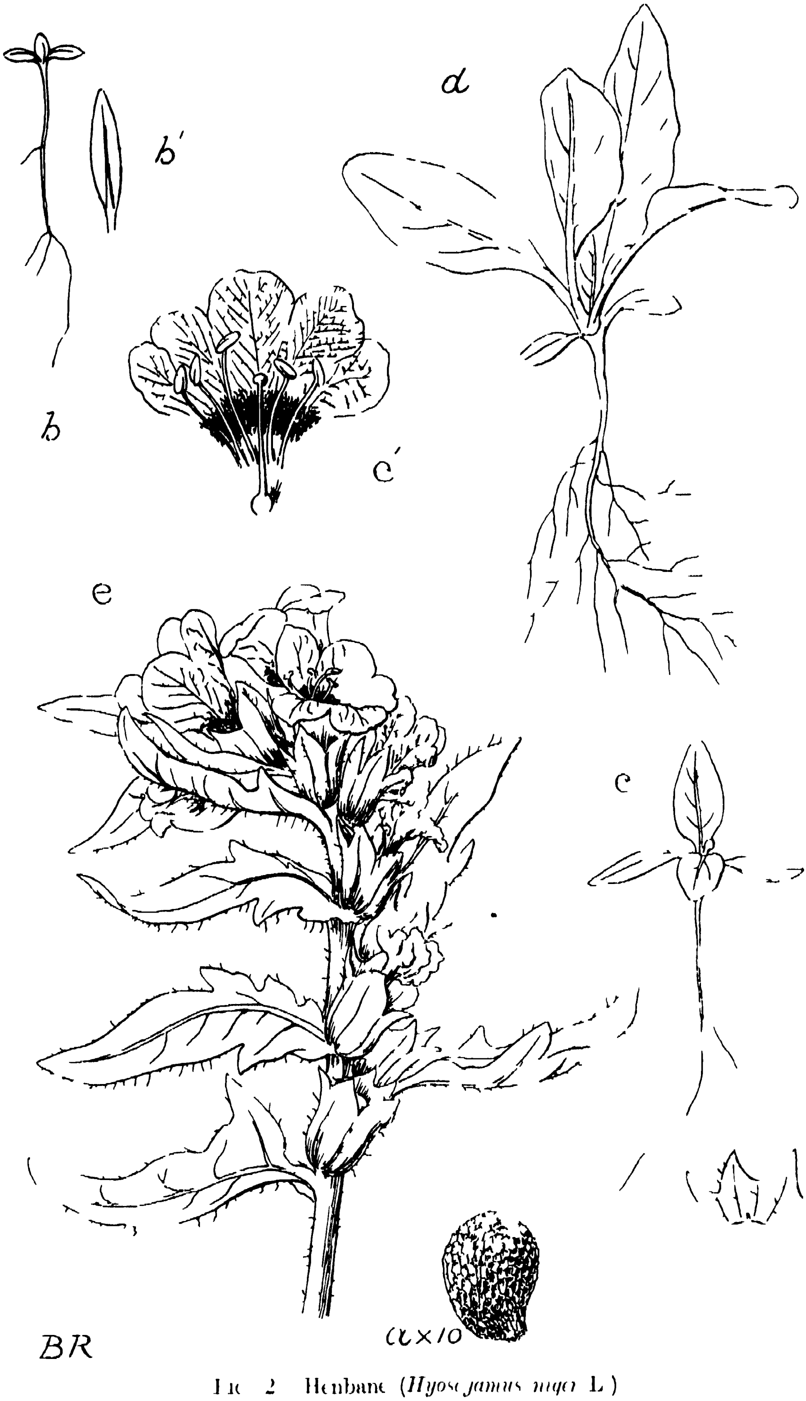

Fig. 2. Henbane (*Hyoscyamus niger* L.)

a, Seed natural size and × 10; *a′*, Capsule natural size; *b* and *b′*, Seedling first stage and seed leaf × 1; *c*, Seedling second stage × 1; *d*, Seedling third stage × 1; *e*, Flowering and fruiting branch × 1; *c′*, Flower, opened to show stamens and pistil, enlarged.

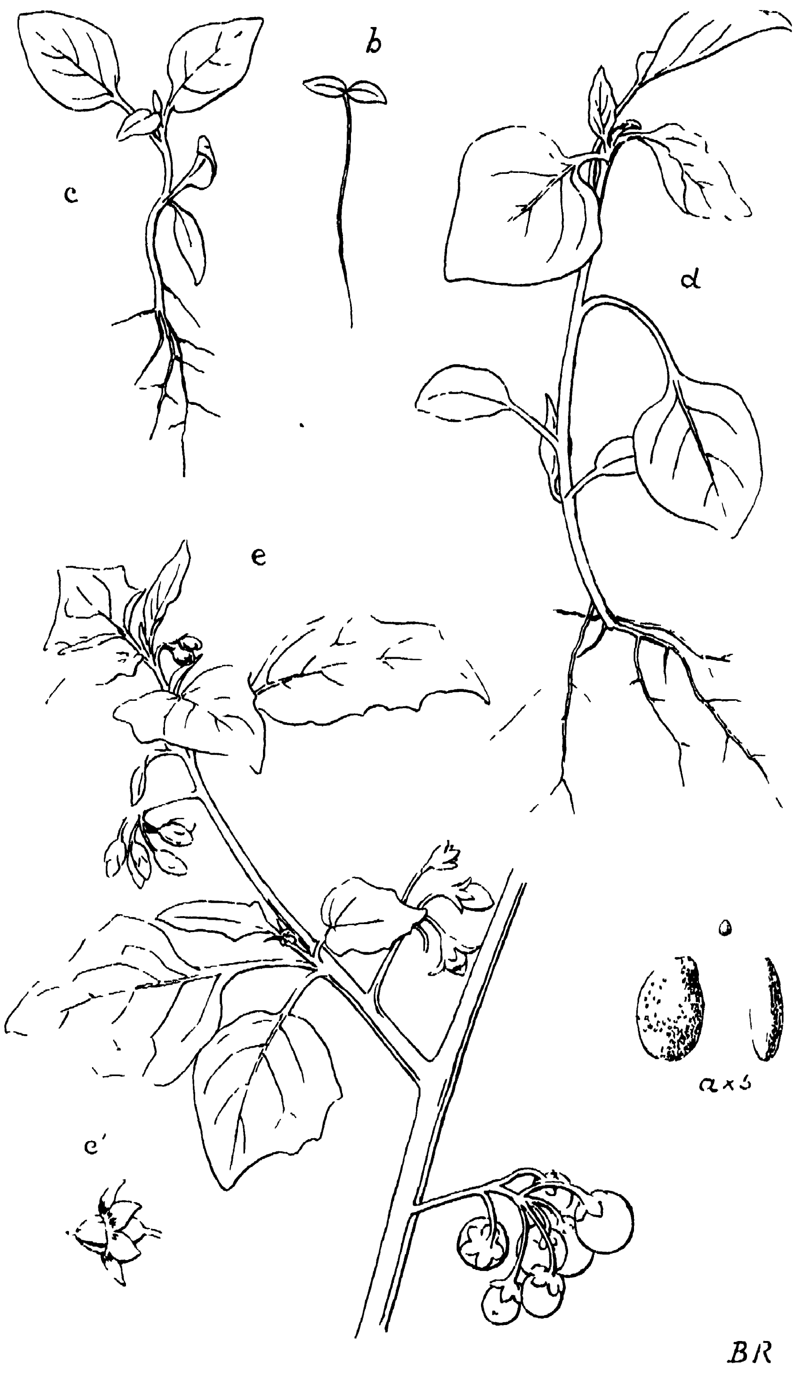

FIG. 3.—Black Nightshade (*Solanum nigrum* L.)

a. Seed, natural size and 5; *b*. Seedling, first stage 1; *c*. Seedling, second stage 1; *d*. Seedling, third stage 1; *e*. Flowering and fruiting portion; *e′*. Flower, enlarged.

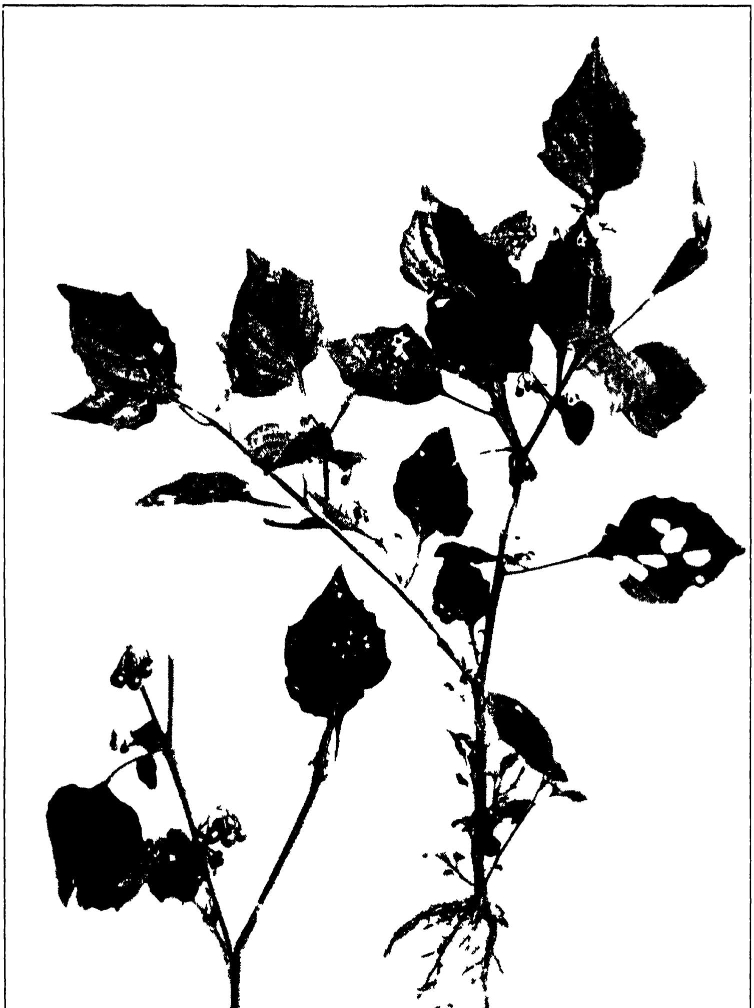

FIG. 4. Black (Garden) Nightshade (*Solanum nigrum* L.), showing flowers and berries.

FIG. 5 Black Bryony (*Tamus communis* L.)

FIG. 6 Darnel (*Lolium temulentum* L.) $\frac{2}{3}$ with (1) spikelet enlarged

The berries are nearly egg-shaped, and are red or scarlet in colour. The rootstock is extensively creeping, and the plant is a perennial. To the taste, the stem of the plant is at first bitter and then sweetish; hence one of the common names. Bitter-sweet is found throughout England and Ireland, but is less common in Scotland.

The poison is the alkaloid solanine, which occurs in the stem, leaves, and berries, and there is no doubt that it is poisonous both to man and to farm live stock. Poisoning in human beings is usually confined to children who may eat the attractive berries. This plant probably varies in its poisonous properties according to season, and it may be said that stock do not take it very frequently considering that it is so plentiful. Nevertheless there can be little doubt that it has caused many losses of stock. Poisoning of sheep was recorded in 1906 (*Vet. Record*), and deaths of cattle in the same year (*Farmer and Stock-Breeder*). Although stock rarely touch the plant they may occasionally do so when cropping leaves from hedges, especially perhaps when pastures are bare, and it may then prove harmful. A case is quoted in the *Journal of the Royal Agricultural Society* (1905), in which it was eaten by a cow along with meadow saffron, with fatal results. A writer in the *Mark Lane Express* in 1911 referred to a veterinary surgeon who had had forty cases of poisoning of sheep the previous season up to the middle or end of July, and although prompt measures had saved most, a few animals had succumbed. In *Bulletin* No. 86, U.S. Department of Agriculture, it is simply stated that, "The berry, though its taste is not remarkably disagreeable, is somewhat poisonous, and it has been shown that an extract of the leaves is moderately so." The plant may be regularly cut down, and if plentiful where cattle are kept the creeping rootstocks may sometimes be removed, though this is generally difficult, owing to the fact that they are usually situated in the midst of the hedge.

Black Nightshade (*Solanum nigrum* L.) is a small branched annual (or biennial) of 6 in. to 2 ft. in height. It has oval leaves and lateral clusters of small white flowers which open during the summer and autumn months. The berries are round, at first green, and later black or reddish-black, resembling black currants. The whole plant (Figs. 3 and 4) is, in Britain, generally smooth, and has a disagreeable odour. It is frequently a troublesome weed in gardens, especially when these are not well cared for. It is stated by Bentham and Hooker that this

plant is "one of the widest spread weeds over every part of the globe, except the extreme north and south, varying so much in warmer regions as to have been described under more than forty names." It is common in England, but quite local in Scotland and Ireland.

Black nightshade contains the poisonous solanine, chiefly in the berries, but also in the leaves and stem. The percentage of the poison present varies considerably with soil and climate, so much so that some authorities appear to have held the plant to be innocuous, while others have noted its extremely poisonous character. For example, Cornevin states that Gohier gave 3 kilos (6½ lb.) in the green state to a horse, and found that it had no serious effects. Henslow states that children have been poisoned by the berries. It is stated in U.S. *Farmers' Bulletin*, No. 86, that "the more musky-coloured plants are the most poisonous. In some the amount of alkaloid in the ripe fruit and leaves is so small that these parts may be, and are, consumed in considerable quantity without any ill consequences. Poisoning does sometimes follow, but it is not clear whether this is due to improper preparation or to careless selection of the parts used. The use of black nightshade for food is certainly not to be recommended." Cattle, calves, sheep, goats, pigs, ducks and chickens have all suffered from poisoning by the plant.

Ewart remarks (*Weeds, Poison Plants, and Naturalised Aliens of Victoria*, 1909) that this plant possesses no virulent poisonous properties, though it is commonly regarded as highly poisonous, partly owing to confusion with deadly nightshade and partly owing to hasty generalization ; that though a small amount of solanine is present in the stem and berries, these are usually less poisonous than green potatoes ; that the berries are often eaten by children without any ill effects beyond perhaps a stomach ache, or, if eaten in excess, sickness and purging, and that the berries have "even been used instead of raisins for plum-pudding with no results out of the ordinary."

The fact remains, however, that the plant is untrustworthy, for it seems quite clear that the berries may be edible in some seasons, countries or localities, and poisonous in others, but any sample may be poisonous.

OAK (*Amentaceae*)

The Oak (*Quercus* sp.).—The ingestion of acorns has frequently caused serious losses among young cattle up to two years old, as in 1808, 1870, 1884, and 1900, when very many

died. Cattle over three years old are seldom affected, while sheep and pigs appear to be almost immune from the poisonous property of the acorns. Some have held that the trouble is chiefly due to unripe acorns, and others that it is only a severe form of indigestion. The subject is not too well understood, but it seems reasonably clear that in certain circumstances and under certain conditions acorns are poisonous to cattle under two years old, and that "acorn poisoning" is quite distinct from indigestion due to eating an excessive quantity of acorns. As the acorns are most likely to be eaten in long, dry, and hot summers, when herbage on the pasture is scarce, efforts should in such cases be made to keep cattle off areas where acorns are abundant. The course of the illness may be rapid, and fatal within twenty-four hours, but more commonly it is progressive, with wasting, loss of appetite, constipation followed by diarrhœa, sunken eyes, temperature below normal, and fatal termination in a few days. It is believed that serious losses were last generally experienced in the year 1900.

It should be added that "oak-leaf poisoning" has been recognized for centuries, and was recorded by Mascal in 1662 (*The Government of Cattel, London*): "Oak-leaves, if sheep eat them green, it is evil for them, especially for young lambs, which will kill them; and likewise of other cattel." In general, when stock have plenty of other food, the consumption of oak-leaves with it may be regarded as harmless, but taken in plenty in a period of drought, or in early spring when grass is short, injury may follow, and even end fatally.

CONIFERS (*Coniferae*)

The Yew (*Taxus baccata* L). is one of our most poisonous plants, but although the wood, bark, leaves, and seeds are all injurious, the scarlet mucilaginous cup enveloping the ripe seed may be eaten with impunity. The old leaves and shoots are the most poisonous parts, and cattle and horses readily eat them. Trimmings which have been carelessly thrown down have also poisoned animals which have eaten them. Stock are perhaps more easily tempted to browse on the dark green foliage in winter, when grass is not plentiful. Symptoms of poisoning are then liable to follow speedily, and death may quickly supervene; in some cases, indeed, with extreme rapidity, as though the animal had been shot.

In the *Journal of the Royal Agricultural Society* several cases of poisoning of farm stock are mentioned (a horse in 1885, deer and horses in 1893, cattle in 1893). In some cases many cattle are affected at the same time; for example, the death

of 15 cattle was recorded in 1912 (*Vet. News*, December 7). Many similar cases have been recorded. The yew has caused the poisoning of horses, cattle, asses, mules, deer, pigs, sheep, rabbits and pheasants, as well as many cases of fatal human poisoning. Many instances, however, have been recorded in which fatal results have not followed from eating the leaves, and it appears that the lower branches of yew trees in parks and grounds are constantly cropped by cattle without any ill effects (*Trans. Chem. Soc.*, 1902; *Jour. Board Agric.*, 1903).

Eaten on a full stomach a small quantity of yew may cause comparatively little trouble. Cornevin concluded, from experiments with autumn and winter leaves, that the quantity of leaves necessary to kill a horse would be 0·2 lb. per 100 lb. live weight, or say 2½ lb. for a 1,200-lb. horse. Much more is required in the case of cattle, 1 lb. per 100 lb. live weight, or 10 lb. for a 1,000-lb. cow. A later writer, Pott, quotes a much lower quantity to kill the horse, saying that 150 to 180 grammes (0·33 lb. to 0·4 lb.) are sufficient to cause death in a quarter to half an hour without symptoms. The yew is irritant and narcotic and may cause vomiting, bloating and giddiness. It is generally agreed that the poisonous principle is the alkaloid taxine, a heart depressant, having a bitter taste, which may cause death from suffocation. The effects are often so rapid that the animals affected exhibit practically no symptoms, but appear to die suddenly, as already noted.

Clippings from yew trees should never be thrown down where they can be eaten by stock, and where yew trees overhang hedges near pastures it is advisable to have them lopped back to a distance out of reach of grazing stock.

Cupressus poisoning has also been recorded as suspected, two instances coming to the notice of the Board (now Ministry) of Agriculture in 1905; the death of cattle was attributed to the poisonous effects of *C. macrocarpa* and *C. nootkatensis*. In one instance four bullocks died, and in another three heifers were stated to have suffered from irritant poison, one of them having died. No information was then available as to the poisonous properties of the two species of Cupressus referred to, and no record could be found of any similar case which would tend to confirm the suspicion that these trees are poisonous to cattle.

BLACK BRYONY (*Dioscoreaeceae*)

Black Bryony (*Tamus communis* L.) is the only British species of the order, and quite unrelated to bryony proper. It is found in many parts of England, but not Scotland, and

only one locality in Ireland, and is a hedge climber, with long trailing stems many feet in length, often overtopping tall hedges and hanging in festoons. It has a large dark-coloured, fleshy rootstock, which contains much starch; bright, glossy, heart-shaped, pointed leaves borne on long stalks, and often appearing to be three-lobed; small greenish or yellowish-green flowers borne in slender racemes in May and June, and springing from the axils of the leaves (Fig. 5); and red or scarlet berries, resembling those of bryony, very conspicuous towards the end of summer and in autumn.

It would appear that the leaves and stems are innocuous, but that the root and berries are poisonous, the former being very acrid and cathartic, causing death if taken in quantity, while the berries may cause vomiting, intestinal pains, paralysis of the hind quarters, and death. Cornevin states that the purgative properties of the root have long been known, and that the root has been used in popular medicine for reducing contusions, whence a vulgar name for the plant in France was *Herbe aux femmes battues.*

THE GRASS FAMILY (*Gramineae*)

Darnel (*Lolium temulentum* L.) was formerly a fairly common plant in cornfields. It is annual, much resembling ryegrass (*L. perenne*), but without stolons, and the spikelets are similarly placed edgeways on the flowering stem, in this respect differing from couch grass (*Agropyrum repens*). The empty outer glume generally exceeds the spikelet in length, this point effectively distinguishing it from ryegrass. It attains to 2 ft. in height, and flowers from June to August (Fig. 6).

It should be said that in its earlier stages the green plant is not unsuitable as a food for stock, as it is the seed or grain only which is poisonous, and this not invariably so. The principal danger is that the seed may be mixed with wheat for bread, or with stock foods. The seeds have been regarded throughout the centuries as harmful and as having a special effect on the eyesight of man—as when Ovid says, "Let the fields be clear of darnel that weakens the eyes." A further effect is referred to by Gerarde (1597): "The new bread wherein Darnell is, eaten hot, causeth drunkenness."

According to Anne Pratt, Johnston records a case "which occurred on Christmas Day, 1853, at Roscrea, in Ireland, when several families, containing not less than thirty persons, were poisoned by eating darnel flour in their wholemeal bread.

They were attacked by giddiness, staggering, violent tremors succeeded by impaired vision, and partial paralysis, and they were afterwards much reduced in strength." Johnson and Sowerby (*British Poisonous Plants*, 1861) say that this grass is very plentiful in Syria and "appears to have been the Zizania of Scripture, mistranslated 'Tare' in our version, but evidently a corruption of zizana, the Syriac name of the darnel. The plant has long been known in the East for its intoxicating qualities, and has frequently caused serious accidents." It would seem that the effect of darnel differs according to individual constitution, and the authors cited immediately above record several cases of severe poisoning and death caused by consuming the grain when made into bread. Darnel has a somewhat disagreeable taste, and this is brought out by Shakespeare in *Henry VI* :—

> Want ye corn for bread ?
> I think the Duke of Burgundy will fast
> Before he'll buy again at such a rate :
> 'Twas full of darnel : Do you like the taste ?

and again he refers to the grass in cornfields :—

> Darnel and all the idle weeds that grow
> In our sustaining corn.

Among the Romans it was believed that darnel caused blindness, and of imprudent or shortsighted men they said : "He feeds on darnel." In France the weed is called *Ivraie*, because when brewed with barley, it acts as a narcotic intoxicant. Indeed, it is remarked by Cornevin that it was so often intentionally mixed with barley for the purpose of giving a higher flavour to beer in the Middle Ages that laws were passed forbidding the addition of darnel to beer.

Though darnel is harmful both to men and animals, it has been eaten in the form of bread with impunity, and though it has caused many cases of human poisoning, fatal results are rare, and Dr. Taylor knew of no case up to 1859.

The *Veterinarian* (1842) records that when mixed with barley darnel caused the poisoning of pigs ; in several cases it is stated (Johnson and Sowerby, 1861) to have proved fatal to horses and sheep ; and at the Lyons Veterinary School a horse was killed by giving it about 4½ lb. of darnel.

In general the hyphae of the fungus *Endoconidium temulentum* are found in the grain, and according to Esser most authorities found that the fungus alone contains the poisonous principle. The poison seems to act as a narcotic and irritant,

and it is said that the dangerous properties are most conspicuous in wet seasons.

The starch granules of darnel are easily distinguished from those of wheat, barley, etc., with which they may be mixed. They are much smaller, usually simple, but sometimes composed of three to five granules.

A dose of 30 grammes of darnel flour appears to be the maximum which an adult human being can take without bad symptoms, after which there is danger. The weight necessary to kill equines is about 7 grammes per kilogramme of live weight, but ruminants and poultry appear to be little affected, it being necessary to give 15 to 18 grammes per kilogramme of live weight to produce symptoms of poisoning. Pigs are very little affected (Cornevin).

Great care should be taken that the seeds of darnel are not ground up with wheat into flour, or with other cereals, while equal care should be observed that none are sown with seed corn—as, indeed, they are rarely likely to be.

SUGAR BEET AND SOIL FERTILITY

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A QUESTION arising from the development of sugar beet cultivation in this country is "What effect on soil fertility results from the growing of a root crop to be sold off the farm ?" The consumption of roots by live stock has always been regarded as one of the means by which the fertility of the soil is maintained. To sell off a root crop, therefore, is not considered good farming practice, and is guarded against in tenancy agreements by restrictive covenants and by penalties for their violation. It is doubtful, however, whether fertility was actually maintained by this means in the past. When once the farming community had advanced from producing food simply for the farmer, his family, and his neighbours, to the stage where meat and corn were produced for sale in industrial centres at a distance from the districts where they were raised, considerable losses in soil fertility must have taken place unless replaced from outside sources.

Farming to-day is even more complex. It is a business which comprises the production and sale of meat, milk, butter, cheese, eggs and wool, as well as of corn and of various root

crops. It is well understood that fertility is lost to the land by these means, and that it must be made good through the purchase of feeding stuffs and fertilizers. It is only by striking the profit-and-loss account of these items that the balance for and against any system of farming can be ascertained. For this reason the sale of a particular crop, even a root crop, can only be fairly regarded as detrimental to the maintenance of the soil in a fertile state, if it can be proved that its effect is to put the balance on the wrong side of the account.

Although the approach to the question of the maintenance of soil fertility on the above lines is at present impossible with the sugar beet crop, yet the existing practice in relation to the raising of this crop and other comparative data can be adduced to indicate whether or not fertility is likely to be lost.

Any given crop will not always remove exactly the same quantities of the various manurial ingredients, but the following table may be taken as showing the ordinary losses per acre of land by the removal from it of an average crop of mangolds, potatoes, or sugar beet. The figures or wheat are also shown as an example of the effect of a corn crop on the soil, and because there is evidence that in some cases the sugar beet crop has cut into the corn acreage.

TABLE I.—AVERAGE MANURIAL INGREDIENTS LOST TO THE FARM PER ACRE OF CROPS GROWN

Crop	Average yield, 1925*	Nitrogen	Potash	Phosphoric acid
		lb.	lb.	lb.
Wheat (grain)† ..	.. 18·2 cwt.	38·5	10·5	16·1
Mangolds (root)†‡	20·0 tons	44·6	50·6	8·3
Potatoes (tubers)†	6·6 tons	50·6	84·2	23·7
Sugar beet (root)‖	8·0 tons	32·0	56·0	16·0

So far as nitrogen is concerned, it should be borne in mind that the loss from the soil of any excess of this substance is not necessarily due to its removal by one crop rather than by any other, because it is probable that, even had there been no crop in the ground, the excess nitrogen would have been lost in the drainage. Apart from this consideration it is seen that sugar beet has a favourable margin as compared with

* *Agricultural Statistics*, Part II, 1925.

† Calculated from *Chemistry of the Farm*, Warington.

‡ Manurial ingredients re-calculated to show *net loss*, assuming roots to be fed to stock, and allowing for losses in dung, making on Voelcker and Hall's basis, *e.g.*, 50 per cent. of the nitrogen and 25 per cent. each of the potash and phosphoric acid.

‖ Calculated from figures supplied through the Rothamsted Experimental Station.

the other crops, and especially as compared with potatoes, of which a normal crop removes as much as 58·1 per cent. more nitrogen than does a sugar beet crop.

The losses of potash and phosphoric acid through drainage are negligible. As regards the former, the sugar beet crop involves the farm in a slightly greater loss than would be incurred through a similar acreage of mangolds, but the loss is very much less than in the case of potatoes. As would be expected, all these crops are at a disadvantage when compared with a crop of wheat. As far as phosphoric acid is concerned the average sugar beet crop compares favourably with wheat and potatoes, but it uses about twice the quantity lost through a crop of mangolds. It will be shown later, however, that no serious detriment to the soil is likely to result from the removal of this amount of phosphoric acid.

The foregoing arguments are based, however, on average theoretical conditions, and, in any case, as has been already explained, the answer to the question of fertility does not rest merely in knowing what chemical substances are removed with the crop, but rather in ascertaining the balance between the quantities thus removed and those previously applied to the land in the form of natural and artificial manures.

In the appendix to a report published in 1924* may be found a table showing the manuring adopted for the 1924 crop by some 27 growers of sugar beet, representing 34 sets of crop results distributed over 11 counties. It is possible, therefore, without entering into any elaborate discussion on the chemical aspect of the matter, and without attempting to generalize, to discuss the situation disclosed on the farms whose actual practice is recorded there.

If the farms of a special nature, such as sewage farms, are excluded, it is shown that 3,640 tons of washed sugar beet, representing 31 crops (*see* Table II), were sent away from 345 acres. Now, in order to secure this crop, these farmers applied 999 tons of farmyard manure, 199 cwt. of sulphate of ammonia, 151 cwt. of nitrate of soda, and 90 cwt. of nitrate of lime, giving a total addition to the soil of about 22,700 lb. of nitrogen. They also applied 584 cwt. of kainit and 211 cwt. of muriate of potash, which, together with the potash in the farmyard manure, would account for about 28,000 lb. of potash. In addition, 1,078 cwt. of superphosphate

* *Sugar Beet: An Inquiry into the Cost of Production, Yields and Returns in 1924*, by A. Bridges and R. N. Dixey. Research Monograph No. 3, Ministry of Agriculture and Fisheries. Price 1/- post free.

of lime were applied to this crop, giving, when taken with the farmyard manure, some 21,600 lb. of phosphoric acid. There were also used 227 cwt. of special sugar beet manure and 90 cwt. of shoddy, and these have been taken at average analyses. It has been assumed that the tops and leaves of the beet would be returned to the soil, and accordingly no deduction has been made for the manurial constituents contained in them. In cases where they are fed to stock there would be a small loss to the soil through the sale of meat or milk, and in the process of dung-making.

Table II shows the gains to and losses from the soil on this basis, the farms being grouped according to whether farmyard manure was applied directly to the beet crop, or whether artificials only were used. The result for the whole acreage is also shown, and the figures have been re-calculated on a per-acre basis.

TABLE II.—GAINS AND LOSSES OF MANURIAL INGREDIENTS PER ACRE (31 SUGAR BEET CROPS, 345 ACRES, IN 1924)

	Nitrogen lb.	Potash lb.	Phosphoric acid lb.
FARMYARD MANURE GROUP—			
Farmyard manure	115	57	41
Artificials	30	86	39
Total added to soil	145	143	80
Taken from soil (in the roots) ..	45	78	22
Receipts exceed losses by ..	100	65	58
NO FARMYARD MANURE GROUP—			
Added to soil (in artificials) ..	29	58	60
Taken from soil (in the roots) ..	41	71	20
Losses exceed receipts by ..	12	13	—
Receipts exceed losses by ..	—	—	40
ALL FARMS—			
Total added to the soil	71	89	68
Total taken from the soil ..	42	74	21
Receipts exceed losses by ..	29	15	47

As shown by this method of calculation, these farms, taken as a whole, gained rather than lost fertility to the extent of 29 lb. per acre of nitrogen, 15 lb. per acre of potash, and 47 lb. per acre of phosphoric acid, as a result of growing sugar beet. A consideration of the farms, when grouped according to whether the crops were grown with farmyard manure or with artificials only, however, shows that a favourable result

as regards soil fertility is not a universal rule of sugar beet growing. As far as phosphoric acid is concerned, there would seem to be very little danger of loss, since even the farms which used artificials only are seen to have given the soil three times as much of this substance as the crop took out. Nevertheless, in the case of the losses of nitrogen due to the crop, as opposed to those due to drainage, the favourable result is seen to depend on the use of dung. Thus, whereas the farms using farmyard manure show a very safe margin in this respect, those farms where artificials only were applied incurred a small loss, *viz.*, of 12 lb. per acre, an amount representing approximately 0·5 cwt. of sulphate of ammonia.

Potash also shows a loss of 13 lb. per acre on the second group, and, as in the case of nitrogen, there is a considerable gain in the first group. Unlike the case of nitrogen, however, this gain does not depend on the use of farmyard manure, since it is shown that, had no farmyard manure been used, there would still have been a small gain of potash, *viz.*, of 8 lb. per acre, and potash may, therefore, be regarded as about level.

There is no reason to suppose that any heavier manuring was practised here than would be used in general, so that on the whole there would seem to be little risk of soil impoverishment. It should be borne in mind, however, first that sugar beet takes a heavy toll of potash, and, secondly, that when farmyard manure is not applied to this crop generous doses of nitrogenous fertilizers would seem to be desirable.

ASPARAGUS AND ITS CULTIVATION

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ASPARAGUS (*A. officinalis*) is a well-known vegetable which has been cultivated in this country for over 300 years. It is a native of Europe and Asia and is to be found growing wild in certain districts. Belonging to the natural order Liliaceae, it is a perennial, with a creeping rootstock from which branching stems are produced annually. The flowers are greenish-white in colour, supported by slender pedicels in the axils of the main branches. The "seeds" or berries are small and red when ripe.

Suitable Soils.—The cultivation of asparagus is possible on most soils. The alluvial soils near Colchester, the heavy loam of Evesham and the sandy loam of Cambridge are all used for

the cultivation of this plant, and each district is noted for high-class produce. Sandy loam is the ideal medium for its cultivation because it gives earliness, good aeration and drainage, and is easily worked. Any soil, however, if it is well drained and aerated, can be brought by mechanical means into the necessary condition, *i.e.*, one which offers little resistance to the emission of the fleshy roots or the protrusion of the succulent or edible stems of the plants. The soil should be capable of receiving and parting with water readily.

Preparing the Land for the Plants.—Asparagus is a vegetable which does not enter into the usual rotation of crops and has to occupy the same site for a period extending to 20 or more years. It is therefore of the utmost importance to exercise a great deal of care in preparing the land at the outset, as future improvement can only be accomplished by surface dressings. Asparagus cannot be transplanted successfully after the crowns are a few years old. The plant sends its roots down deeply, and it is admitted that the best results are attained by trenching deep soils, though usually this is only possible in gardens. Where field cultivation is practised, the ground should be well dug before planting, and manured with farmyard manure or vegetable refuse if such is available. Old mortar rubble makes heavy soils more porous and should be used for sticky land. Light lands, though well drained, are often deficient in humus and must receive liberal dressings (25 to 30 tons per acre) of farmyard manure and vegetable refuse if good results are to be obtained. A dressing of basic slag, 10 to 15 cwt. per acre according to the lime content of the soil, can be applied with beneficial results at the time of preparing the land. The preparation of the land is best accomplished early, preferably in the autumn, to ensure that it is clean and free from weeds and settled down in time for either planting or seed sowing in April. Where the soil is heavy and drainage poor, raised beds are found to be advantageous. Such beds should be made 4½ ft. wide to take three rows, or 3 ft. wide to take two rows of plants, with a distance of 2 ft. between the beds. It is not necessary to form raised beds when the soil is a sandy loam with good drainage. In the Evesham district, many growers favour single rows 3 ft. 4 in. to 3 ft. 6 in. apart, with plants 10 in. to 1 ft. apart in the rows, as this avoids the overcrowding of roots, facilitates the tending of the beds and easier cutting of the heads.

It has been a common practice to give an annual dressing of salt to the beds in the spring, and no doubt this custom had

its origin in the fact that asparagus grows wild on the sea coasts. The results of experiments, however, suggest that the influence of salt is inconsiderable, while, incidentally, it has a detrimental physical action on some soils.

Sowing the Seed.—Seed, which must be plump, should be sown in April in seed beds which have been specially prepared in autumn by digging in well decomposed manure. The soil should be in a friable condition and well pulverized, and the beds carefully levelled with the aid of a rake. The seed should be sown in drills 1½ in. deep and 15 in. between the drills, and, as it is slow of germination, it is a good plan to sow a little radish seed with it. The latter germinates quickly and thus proves useful in defining the ultimate rows of asparagus. This enables the cultivator to commence hoeing between the drills before the asparagus has germinated, to keep down the weeds, and at the same time it aerates the seed bed. As, however, asparagus is the primary consideration, the radishes should be removed as soon as the former has appeared.

Transplanting from Seed Bed.—When one year old, at which time they give better results, the plants should be carefully lifted out of the seed beds with a fork or spade, so as to avoid breaking the roots, and planted 10 in. to 12 in. apart in the drill. Planting should be carried out according to the season and climatic conditions, but, in any case, not before the end of March. Avoid the "drying" of the roots and so prevent an unnecessary check to growth. The method of planting varies in minor details in different districts. In the Evesham district a "channeller" is used for this purpose and is an excellent tool in capable hands for removing the soil out of the trench or channel ready for planting operations. This tool is an equilateral triangle of steel fitted to a long handle. The channel should be at least 3 in. deep to receive the crowns which are placed or planted on their sides, and part of the removed soil should be carefully worked round and over the plants. The earth must be pressed gently about the crowns, and when later the "buds" commence growing the remainder of the soil should be placed over the crowns. A quicker method, after the drill is prepared, is to cut off the long roots to a uniform length, and to dibble in the crowns so that the tops are flush with the bottom of the drill. Intercropping during the first year may be practised with either dwarf peas or beans.

Varieties.—The following are the varieties in general cultivation: Connover's Colossal, Palmetto, Argenteuil Giant Purple, Argenteuil Late Purple, and Giant Dutch. The variety

commonly grown in the Evesham District is Bedenham's Purple Giant, which is said to be a sport from Connover's Colossal. Most of the principal growers now have their own strain, hence it is difficult to mention specific varieties.

Manures.—It is well to remember that the object of manuring is to encourage growth after the season's "cutting" has ceased, and to build up strong crowns for the ensuing season. The time of application to achieve this object is after the beds have been cleared by cutting down the ripened growth or haulm. Well-rotted or decayed manure at the rate of 12 tons per acre, supplemented by 4 cwt. of superphosphate and 1 cwt. sulphate of potash per acre should be applied. A spring dressing of n trogenous manure is useful and 4 cwt. of nitrate of soda per acre would prove beneficial if given just prior to growth commencing. An occasional dressing of old soot, at the rate of 8 cwt. per acre, has given good results; and as an alternative 15 cwt. of fish meal and 1 cwt. of muriate of potash may be applied.

Routine work during the first two years will consist chiefly in maintaining strong sturdy growth with the aid of top dressings in the autumn, and the eradication of weeds by frequent hoeings as already described. On no account must the grower cut any shoots during the first two years, as to do so would be to destroy the future quality of the produce and incidentally reduce the longevity of the plants. As soon as the haulms ripen, they should be cut down close to the ground; the ground forked slightly among the plants and a layer of well-rotted manure added. This can be covered with about 1½ in. to 2 in. of soil from the alleys.

Gathering.—Cutting may commence in the third season, and, in order to obtain the long "grass" for market purposes, it is advantageous to earth up the crowns. Sufficient soil should be placed on the crowns to allow 6 in. of white stem, leaving some to spare for knife play; otherwise damage might be done to the crowns. The time of cutting will depend upon the district and season, but in early districts cutting may commence in mid-April and continue until about the third week in June. In the Evesham district cutting is not continued in the first year of cropping after the first week in June. Great skill is required, when cutting, to avoid damaging the crowns, and it is at this stage that the advantage of planting the crowns deeply in the first instance is observed. Several types of knife are used, but mention may be made of one known as the four-pronged asparagus knife. When cutting, the knife should be put down,

vertically, close to the bud; the hand is then brought back so that the knife is held at an angle of 45° and the bud is cut. As the value of asparagus depends on its freshness, exposure to the heat of the sun must be avoided, and it is always advisable to place it as soon as possible in a cool shed before packing. The beds will need to be cut over every day in hot weather; otherwise the grass may grow too long. When it is not possible to send the grass away on the day of cutting, it should be packed firmly in a receptacle such as a flat or pot and stored in a cool and not too dry store. It may also be stored in damp sand or under a damp cloth. The stems go crooked if the ends are stood in water.

Marketing (*Preparation for Markets*).—To obtain the best prices a system of grading must be practised. The "buds" or "grass," as the asparagus shoots are called, must be carefully sorted and placed in first, second, or third grades. This operation is known as "scoring," and means putting up in bundles or "hands" containing 15 or 20 buds. The asparagus, if dirty, should be washed either before scoring or after the bundles are tied. The buds can either be put up in eight bundles of 15 or in six bundles of 20. Special bundles are put up of the very best buds, and two or three of these bundles, each weighing 12 lb. to 15 lb., are packed between straw and marketed in "flats." Ordinary bundles, 3½ lb. to 5 lb. each, having eight to 10 stems in a packet, are put up between layers of straw in "pots" or "pads." Green packing material is not advisable, as there is a tendency for this to heat and cause blemishes to appear on the asparagus. For scoring, the ends of the "buds" are placed level against the end of the scoring box. A rectangular box is now generally used with a piece of each of the longer sides removed in the centre. Across this opening the raffia is placed and the score is then tied without being removed from the box. By this method a satisfactory score is obtained, which has a nice flat appearance and fits well into its place in the "hundred."

The "scores" are next made into "hundreds" (120 buds) and placed on a bench with their heads in one direction. On each side of the scores there are holes in the bench and through these a webbed belt is passed and fastened underneath. Midway between these holes there is a smaller hole, through which the looped end of a willow twig is passed. Another twig is now placed horizontally on the bench so that it lies between the ends of the other twig. The scores are now placed one on each side of the upright twig and so that they lie across the horizontal one.

Two more scores are placed on these two, and the remaining two are placed one on either side of those already in position. If, however, eight scores of 15 buds in each are used, two scores are placed on either side of the central twig and four other bundles are laid on these. The belt is now placed across the scores and made taut by pulling the belt down through the holes in the bench with either foot. The ends of the horizontal twig are now pulled up over the scores and twisted round as tightly as possible. The ends of the upright twig are then lifted as high as possible, twisted round and placed underneath the first twig. This tightens the whole bundle and prevents the buds from moving. Another method of packing is practised where bundles are put up weighing 3 lb., and half bundles of 1½ lb. weight. These are packed in flats holding 20 bundles each. The flat is commonly used for the London markets, the pot for the Northern.

Recently, a machine for bundling asparagus has been produced by a growers' association in this country; this embodies certain improvements on a pattern which is largely used in the United States. It consists of a pair of semi-circular castings, hinged on one side, with a handle on the opposite side, which, when closed, are held by a notched piece (*see* Fig. A, Plate 11) so that the bundle of asparagus can be tied firmly at each end. Pressure of the small lever under the handle releases the notch, the upper casting is then turned back and the bundle removed. The castings are lined with a pair of nickel springs, about an inch wide, completing four-fifths of a circle; these hold the loose sticks in a rounded position while the appliance is being filled.

Length of Season.—Imported asparagus generally arrives early in February, and is followed in Covent Garden by produce from Devon and Essex about the end of the month. Worcester asparagus arrives about the beginning of May. The early samples are put up in bundles of 45 to 50 buds or heads.

Forcing Asparagus.—Forced asparagus can easily be obtained where the grower has an abundance of three-year-old or older crowns. Age does not count in this operation as long as the crown is vigorous. Ordinary hotbeds can be made up in the same manner as that necessary for growing cucumbers, with sashed frames placed upon the top of the fermenting material. When the temperature does not exceed 100° F., a layer of rotted manure and soil should be added. The latter should be made firm. The plants are lifted with soil adhering and are then placed in the frame closely packed together, *i.e.*, one lot of

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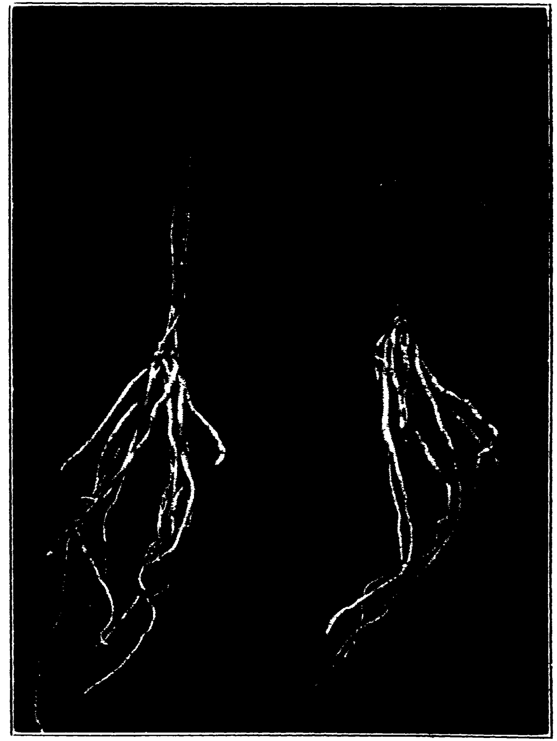
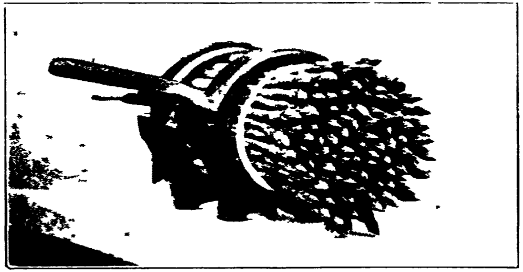
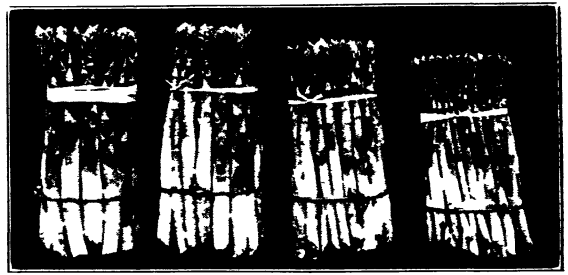
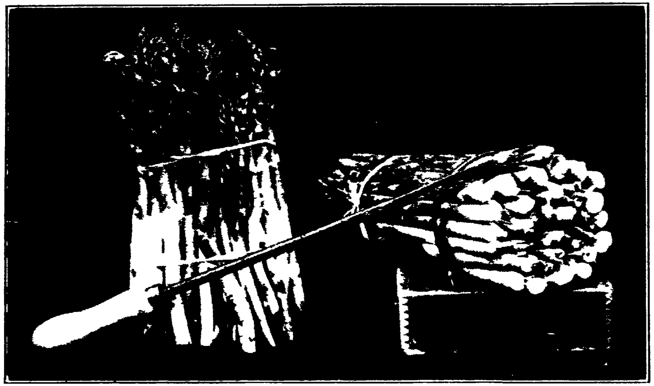
Showing types of crowns with a few large buds.

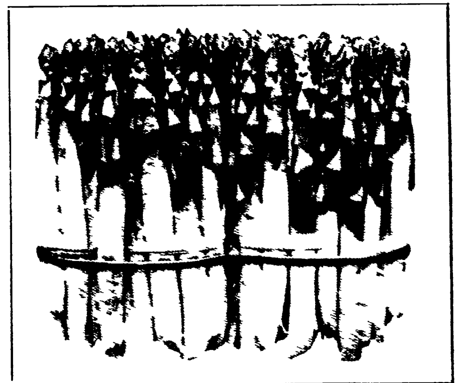


Crowns same age as those on the left, but with smaller and more numerous buds. Should be discarded and not planted.









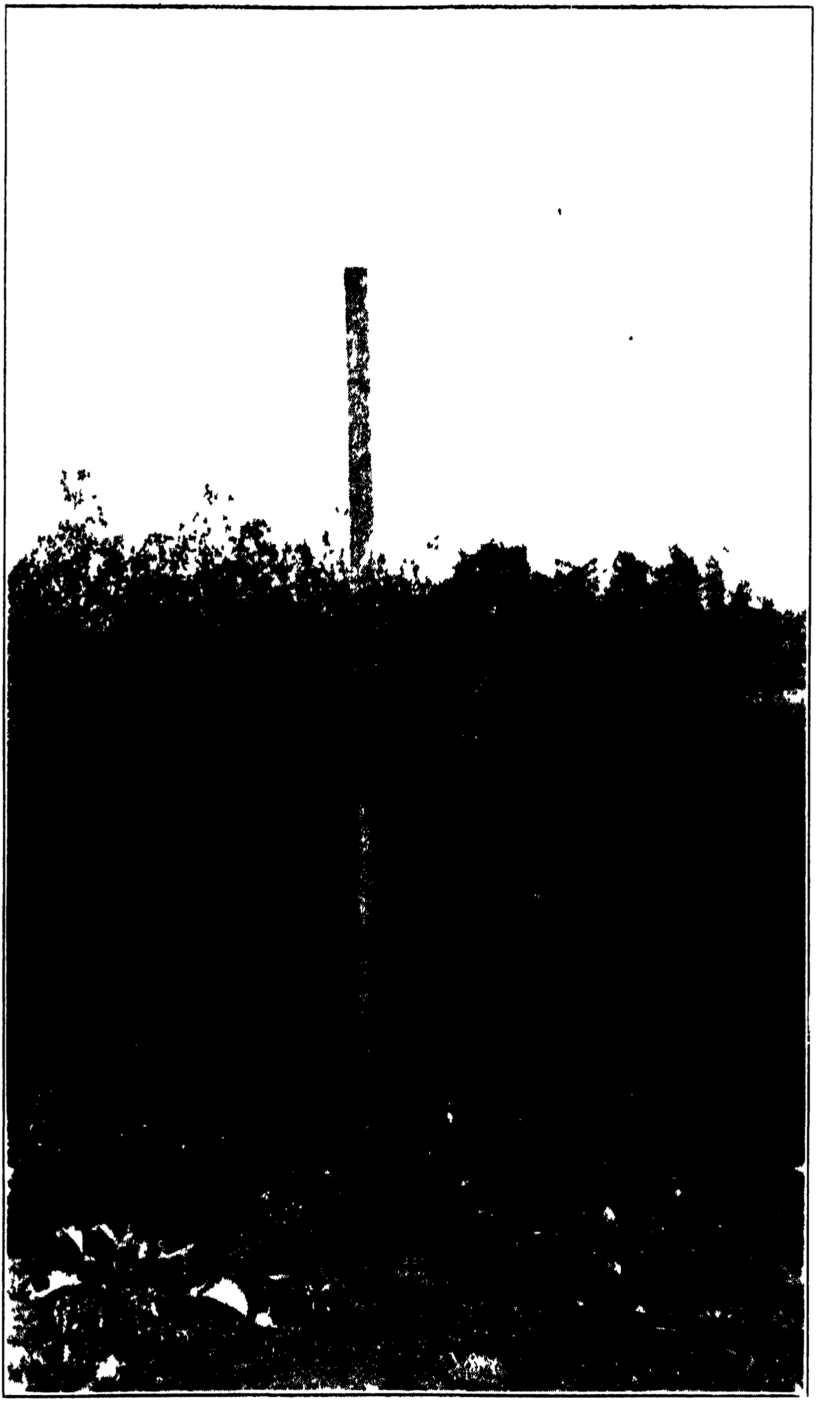
A The bundling machine

B Good bundles of asparagus. Showing left to right Giant, Selected, Domestic and Prime grades. Tied in bundling machine

C Bad bundles of asparagus. That on left shows bad loose tying, dirty buds, open buds, eaten buds and crooked buds

D A good "hundred" of asparagus packed in the general way

Shows a suitable asparagus plant for seed purposes, with a clear stem of about two feet



Shows an asparagus plant with a clear stem of about a foot. Seed saved from this would tend to throw open buds

roots placed upon the next. When the frame has been filled with neatly packed crowns, these are covered with rich soil about 4 in. in depth. The frame should be kept closed for a few days until the heat comes through. A little ventilation should then be given to allow the steam to escape. As the asparagus shoots appear, air should be admitted judiciously on all favourable occasions. A sprinkling of tepid water should be applied daily according to the weather. Forcing can be easily accomplished in hot-houses where a temperature of 70° F. can be maintained. Beds or boxes can be used. A humid atmosphere should be kept by occasionally watering the beds. Forcing must be carried out rapidly to ensure success, and for this reason a high temperature is essential and must be maintained. To allow a cooler temperature after forcing commences will cause the resultant shoots to be tough and unfit for the table. A series of batches will be necessary to maintain a continuous supply of shoots from the end of December until the spring, and it will be found that the earliest plantings will require the most attention. During spells of inclement weather it may be necessary to protect the frames by placing mats over the lights and linings of hay, straw or bracken round the outsides of the frames. Watering must be increased as the cropping develops, and occasional use of manure water will strengthen the "grass."

Forcing (*Commercial Method*).—In the Exeter district the forcing of asparagus is still carried out. Crowns three years old are used for this purpose, and these are transferred to cucumber houses having bottom heat. Half an acre of roots will occupy approximately 1,000 sq. ft. in the house. The roots are ploughed out with a digger plough, and six men with forks are required to keep one team of horses moving. In such a manner one acre of crowns can be ploughed out in from three to four days. The houses are filled at frequent, regular intervals to ensure a succession of crowns. These are laid upon their sides and covered with a few inches of soil. A humid atmosphere is maintained, with the temperature ranging about 70° F. Forcing occupies anything from 14 to 20 days, according to the time of year. The packing, grading and marketing operations are identical with the methods already advocated except that the bundles will be smaller. Prime "grass" is sent to London in round bundles of 40, four bundles to the box.

Seed Saving and Improved Crops.—American experience suggests that only about one crown in every 10 crowns in the seed-bed is really satisfactory. The small crowns, and the large crowns with quantities of small buds, should be discarded,

because they develop much low-priced " spruce." Large crowns with big buds should be selected, for these develop asparagus of size and vigour. When saving seed, selected buds which commence branching high up the stem should remain uncut and be allowed to run to seed, but clearly some male plants must exist in the bed or fertilization will not occur.

Asparagus Beetle (*Crioceris asparagi*).—This beetle at times does harm to asparagus (especially in beds which have been established from one to three years) by eating and disfiguring the heads as they are formed. The stems and foliage are attacked both by the beetle and its larvæ. Masses of sticky eggs are also laid on the heads, which have the effect of spoiling their appearance for market.

The adult beetle is a conspicuous insect and cannot be mistaken. It has a black head, the thorax or second portion of the body being red, the wing-cases being black with three pale yellowish blotches down each side. The female lays dusky greenish-brown eggs, which develop into dirty greenish-grey larvæ which are somewhat sticky. The pupal condition is undergone in the soil. The winter is, however, spent in the adult stage, the beetles hibernating amongst any rubbish, etc., that affords shelter. Any good insecticide, either in liquid or powder form, should be efficient against this pest. In the United States of America lead arsenate has been found satisfactory, but it is important to remember that poisonous insecticides must not be used on beds which are being cut. Those growers cultivating asparagus on a large scale could leave small portions of the bed uncut to act as a trap crop upon which the insects might be conveniently dealt with by spraying.

Fungus Diseases of Asparagus.—Two fungus diseases have been recorded on asparagus in this country, namely, " rust " and " coppery web." " Rust," caused by *Puccinia asparagi* DC., has appeared in one or two isolated cases, but fortunately has never made headway here. In the United States of America, however, this disease is often a very serious trouble and has proved very difficult to control.

It is characterized by the presence on the stems and needles of small reddish pustules, which become much darker as autumn approaches. A dusty cloud of spores arises when affected asparagus plants are lightly shaken, and these serve to disseminate the disease. What is sometimes called " rust " in England has nothing to do with the above disease. It appears as a reddish, more or less streaky discoloration of the blanched underground part of the " grass " at cutting time. It is some-

times more pronounced on the three-cornered scale-like leaves, and even those on the upper, green part above ground may sometimes show it. At most this so-called " rust " appears to be rather a mere blemish than a real disease, and little or nothing is yet known as to its cause. When kept in a very moist atmosphere a white mould—a species of Fusarium—often develops copiously on the reddened areas.

" Coppery web " is the name that has been given to the disease caused by the violet root-rot fungus, *Rhizoctonia Crocorum* DC. The underground parts of the plant are the seat of the attack. As a result the overground portions droop and die, and finally the whole plant is killed off. The crowns in the soil become more or less covered with a purplish-brown or violet-coloured spawn or mycelium. From this spawn suckers are sent into the host, which eventually cause its complete exhaustion and death. The fungus attacks not only asparagus, but also saffron-crocus, lucerne, mangold, beet, carrots, potatoes and seakale. Its mode of fructification is still unknown, but compacted masses of the spawn, known as sclerotia, are formed and remain in the soil, thus enabling it to survive unfavourable conditions. Since the parasite is a soil fungus, when once an asparagus bed has become gripped by it, cure is almost impracticable. A new bed should be formed on clean land, and great care should be taken to see that the crowns or roots planted are quite healthy. The plants in the affected bed should be dug up and burned. Bleaching powder at the rate of 2 oz. per square yard may be incorporated with the contaminated soil in the old bed during the summer, and nothing should be planted in it until the effect of this chemical has worked off. The beds should not be planted with asparagus again for a year or two at least, nor should crops of any of the other plants mentioned above be grown in it.

In addition to the two fungi mentioned a third one, *Zopfia rhizophila*, has quite recently been discovered on the roots of asparagus in England. In Italy it is considered that this fungus is a parasite, and is the cause of a root-canker ; but in France, where it also occurs, the fungus is regarded as a mere saprophyte living on old roots already dead. In England, up to the present, the fungus has been found only on old roots, on the surfaces of which it produces its small black spherical fructifications, each about the size of a pin's head. A fourth fungus, *Leptothyrium asparagi*, has been found causing damage to the underground parts of asparatus plants in Italy, but this parasite is not known in this country.

THE GRADING OF POULTRY *

Why Grading is Necessary.—"The greatest problem before the British table poultry industry is that of devising a workable system for the grading of its products." This is an extract from the Report† recently issued by the Ministry of Agriculture after a careful inquiry into the methods of marketing table poultry in this country. The necessity for such a system is particularly felt and becomes increasingly urgent in the case of produce consigned from the surplus-producing areas to the wholesale markets, where it has to be sold in competition with carefully graded supplies from abroad. Imported poultry can be sold on a sample box; practically every parcel of English fowls, on the other hand, must be unpacked in the market, examined and sorted into level lots before sale. Sometimes a rough attempt at grading home produce is made before dispatch from the point of production, but the great majority of home-produced birds reach the market in ungraded lots. The buyer for a large firm of retail distributors recently complained that in order to select the birds required for his clients' trade he had to look over a consignment of 600 English fowls and then only 55 were found to be suitable. As one salesman put it, more business can be done in five minutes with imported poultry than is possible in one hour with home produce.

The Advantages of Grading.—In a carefully graded consignment all birds are alike. It follows that in transactions on the basis of grade, buyers' risks are considerably reduced; inspection before purchase is frequently unnecessary and sale direct from producing areas is facilitated. This cheapens distribution. Grading makes possible long-period contracts between producers and distributors, minimizes disputes, and, what is of increasing importance at the present time, affords a basis for effective advertisement. It promotes confidence and improves the value of the product. A standardized grading system widens the available market and makes possible accurate and comparable price quotations. This last is a pressing need. The present lack of uniform terminology and of well-defined quality distinctions that are understood and accepted generally not only detracts from the value of recorded prices, but leads

* The Ministry's *Marketing Leaflet No.* 2, copies of which may be obtained free and post free on application.

† *Report on the Marketing of Poultry in England and Wales.* Ministry of Agriculture and Fisheries, Economic Series No. 11. Obtainable from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C. 2. Price 6d. net; post free, 9d.

too frequently to a state of affairs on the wholesale poultry markets of this country that is little short of chaotic.

The System Suggested.—In the *Report on the Marketing of Poultry in England and Wales*, to which reference has been made, the following system of classification and weight and quality grading for both live and dressed poultry is suggested:—

Sub-class	Sub-class Specification	Weight Grades (*Dressed Poultry only*)	Quality Grades	Quality Grade Specification
		Chicken		
		Per doz.		
Petits Poussins	—	6 – 7½ lb.		
		7½–9 ,,		
		9–10½ ,,	"A 1"	Milk or specially fed, with white skin, straight breastbone and free from all blemishes.
		10½–12 ,,		
Asparagus	—	12–15 ,,		
		15–18 ,,	"A"	Milk or specially fed.
		18–21 ,,		
		21–24 ,,	"B"	Ordinary, *i.e.*, other marketable birds, including inferior specimens of previous grades.
Spring or Blackberry (according to season)	—	24–30 ,,		
		30–36 ,,		
		36–42 ,,		
			"A 1" (Surreys)	Well-fatted, with white legs and white skin of fine texture, straight breastbone, full-breasted and free from all blemishes.
		42–48 ,,		
		48–54 ,,		
Country	—	54–60 ,,	"A"	Well-fatted or conditioned.
		60–66 ,,		
		66–72 ,,	"B"	Ordinary, *i.e.*, other marketable birds, including inferior specimens of previous grades.
		Each		
Capons	—	Under 7 lb.	—	Superfat and extra fine quality.
		Over 7 lb.		

		Fowls		
			"A 1"	Well-fatted, with white legs and white skin of fine texture, straight breastbone and free from all blemishes.
		Per doz.		
Roasters	Young hens or laying pullets, and semi-mature cockerels	Under 48 lb.		
		48–60 lb.		
		60–72 ,,	"A"	Well-fatted or conditioned.
		72–84 ,,		
		84–96 ,,	"B"	Ordinary, *i.e.*, other marketable birds, including inferior specimens of previous grades.
		Over 96 lb.		

Sub-class	Sub-class Specification	Weight Grades (*Dressed Poultry only*)	Quality Grades	Quality Grade Specification
		Fowls—*cont.*		
Boilers	Hens and cocks	**Each** Under 5 lb. Over 5 lb.	"A 1" "A" "B"	Well-fatted hens, free from all blemishes, with white skin and legs. Well-fatted or conditioned hens. Other hens and cocks.
		Ducks		
Ducklings	Down feathered only	**Per ½-doz.** Under 18 lb. 18–21 lb. 21–24 ,, 24–27 ,, 27–30 ,, Over 30 lb.	"A 1" (Aylesbury)	Well-fatted, with white skin; free from all blemishes.
Young ducks	First adult plumage	Under 24 lb 24–27 lb. 27–30 ,, 30–33 ,, 33–36 ,, Over 36 lb.	"A" "B"	Well-fatted or conditioned. Ordinary, *i e.*, other marketable birds, including inferior specimens of previous grades.
Ducks	–	**Each** Under 5 lb Over 5 lb.		
		Geese		
Goslings or "green geese"	Down feathered only	**Per ½-doz.** Under 30 lb. 30–36 lb. 36–42 ,, Over 42 lb.	"A 1"	Well-fatted, with white skin; free from all blemishes.
Young geese	First adult plumage	**Each** Under 10 lb. Over 10 lb.	"A" "B"	Well-fatted or conditioned. Ordinary, *i.e.*, other marketable birds, including inferior specimens of previous grades.
Old geese	—	—		
		Turkeys		
Young hens	—	**Each** Under 9 lb. 9–11 lb. Over 11 lb	"A 1" (Norfolks) "A"	Well-fatted, with white skin; free from all blemishes. Well-fatted or conditioned.
Young cocks	—	Under 16 lb. 16–18 lb. Over 18 lb.	"B"	Ordinary, *i.e.*, other marketable birds, including inferior specimens of previous grades.
Old turkeys	—	—	"A 1" "A" "B"	Fat hens. Other hens. Stags.

Explanation.—To be effective from a trade standpoint, a fairly wide system of classification and of weight and quality grades is desirable in order to provide for the various ages at which birds are marketed, their varying condition and the seasonal variations in production. The system proposed above covers the field in as simple a manner as possible.

(*a*) *Classes and Sub-Classes.*—The classes require little explanation. The following notes explain the sub-classes :—

Petits Poussins and Asparagus Chicken.—As used at present, the term "petit poussin" covers too wide a range and requires the prefix "large" to describe chicken that have passed the petit poussin stage, but have not yet reached the weight of spring chicken; in the same way, the term "spring chicken" is too elastic and is often used to describe large petits poussins. There is thus an intermediate class of young chicken; birds of this class not only appear on the markets in the spring when larger chicken are scarce, but are being produced to an increasing extent in the late spring and summer, when the demand for them tends to fall off. The term "asparagus chicken" is proposed for this intermediate class and will serve to stimulate demand; it is already used in some parts of the country.

Spring and Blackberry Chicken.—The "spring" chicken is seasonal, but many young birds of this type are produced later in the year. It is suggested that the term "spring" should only be applied to the birds that are marketed in fresh condition and more or less in the spring season when young birds grow rapidly and their flesh is delicate. For chicken of the "spring" type that are hatched in the summer and early autumn the term "blackberry," which is used in some country districts, is suggested. The demand for this class of chicken at the time they are marketed is poor; but, as a class, the birds are suitable for cold storage to meet the early spring demand for small birds before "spring" chicken are available.

Country Chicken.—The term "country," it is suggested, should be used for all large chicken. It is so used now to a large extent, but many unnecessary designations are also in use for this class; some of these, such as "Devon" and "Boston," are of merely local significance and indicate origin or method of dressing. Even the term "Surrey," which has long been recognized on the London market as indicating a specially fattened young bird, is misused in other parts of the country.

Capons.—The term "capon" should be reserved for desexed cockerels of extra-fine quality and not applied indiscriminately to large country chicken as at present.

Roasters and Boilers.—A fair proportion of young fowls are marketed which are too advanced for sale as chicken, but are not yet fully mature. The term "roaster" is suggested to distinguish them from older and inferior fowls for which the term "boiler" is more appropriate.

Ducks and Geese.—"Ducklings," and "goslings or green geese" are customary terms in the trade, but require definition. The descriptions "ducks" and "geese" are also loosely applied. These descriptions are defined on the basis of plumage development.

Turkeys.—The proposed subdivision of "turkeys" into "young" and "old" is obviously desirable; the proposed distinction between cocks and hens in young birds is needed to allow for the superior value of the hens.

(b) *Weights and Weight Grades.*—The general standard of production must necessarily determine not only the range of weights to be attached to each class and/or sub-class of poultry, but the practicability of subdividing the range into weight grades. The main supply of petits poussins ranges from 10 oz. to 14 oz. per bird on the average; asparagus chicken fall within a range of 1 to 2 lb. Four weight grades are practicable for each class, the range per weight grade being 1½ lb. per dozen birds for petits poussins and 3 lb. per dozen for asparagus chicken. Spring or blackberry chicken usually weigh from 2½ to 3 lb. and are covered by a range of from 2 to 3½ lb., which provides for lighter and heavier specimens. Here three weight grades are suggested, but with a range per weight grade of 6 lb. per dozen birds. Country chicken, capons, roasters, and boilers can be of any weight, but the normal weight range of from 3½ to 6 lb. per bird for country chicken and from 4 to 8 lb. per bird for roasters would be covered by the provision of five and six weight grades respectively of a range of 6 lb. and 12 lb. per dozen birds. Capons and boilers do not lend themselves to close grading and two weight grades only are suggested, with a dividing line at 7 lb. and 5 lb. respectively.

Ducklings usually weigh from 3 to 5 lb.: four grades are suggested with additional grades to cover lighter and heavier birds, a range of 3 lb. per half-dozen birds being desirable for each grade; young ducks, as a rule, weigh from 4 to 6 lb. per bird, although ducks of the prolific laying breeds often weigh less; it is, therefore, necessary to provide an additional grade for these and also for birds from 6 lb. upwards, making six grades with a range for each grade of 3 lb. per half-dozen. Ducks are sufficiently provided for by two grades, with a dividing line at 5 lb. Goslings range, on the average, from 5 to 7 lb. in weight and can be covered by four weight grades which allow for smaller and larger birds; a range of 6 lb. per half-dozen birds of each grade is suggested. Young geese fall into two grades, with a dividing line of 10 lb., which may be taken as the average weight. No weight grades are considered necessary for old geese. Turkeys can be sub-classified as young hens, which fall mostly into a grade from 9 to 11 lb., and young cocks of from 16 to 18 lb.; these two grades, with an additional grade for birds over and under these weights, provide three grades for each sub-class. The grade division of old turkeys into fat hens, other hens and stags is sufficient.

(c) *Quality Grades.*—Chicken and fowls fall conveniently into three natural and, in practice, easily determined quality

grades: "A 1," white-skinned, specially fattened birds of the "Surrey" type, which stand in a category by themselves and meet the best class trade; "A," well-conditioned birds of good quality that have undergone short-period conditioning or fattening at the hands of producers or country wholesalers and may have either white or coloured skin; and "B," other marketable birds that are inferior to grade "A," but include inferior or blemished birds from higher grades. Young ducks and geese fall into similar quality grades; the white-skinned and well-fatted birds are finer in quality than the birds with darker flesh. With turkeys the difference is more a matter of condition, but the natural whiteness of the flesh is accentuated by special feeding. It will be noticed that white-skinned poultry take the highest place in the quality grades. This is because there is a trade preference for such birds, which is reflected in prices. Replies to a questionnaire addressed to the principal hotels in the country reveal a unanimous preference for white-skinned birds.

Who should do the Grading?—Large-scale producers who specialize in the production of either eggs or table poultry are in a position to grade their own supplies. On the other hand, farmers and other small-scale producers who market a few live or dressed birds weekly cannot effectively grade their small consignments. Concentration of these small lots at convenient points, preferably in the producing areas, is essential before they can be properly graded. Country wholesalers of the dealer type, who buy birds from farms and at markets, and the few producers' co-operative societies that handle this class of trade, are in a position to grade their output and, in the interests of the industry, should make a point of doing so. They are also in a position to carry out the systematic conditioning of birds for varying periods before slaughter, a process that can be most economically carried out with large numbers: as this gains recognition, supplies will tend more and more to pass through their hands and so facilitate the introduction of a standard grading system.

FEBRUARY ON THE FARM

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In a wet February, little sowing can be done except on light, free-draining soils, but, as a rule, farmers do not worry on that account, for, generally, after a wet period in this month, more favourable sowing conditions may be expected in March. On the excellent farming principle of taking the first chance, however, land that may come into drilling condition in February should be drilled. In a trial, conducted in Derbyshire last year, with Marvellous oats, the difference in yield between February and March sowings was 3 cwt. per acre in favour of the former.

No doubt the higher price ruling for wheat than for oats will create the desire to substitute the latter with spring wheat in districts where spring sowings of wheat may be expected to yield satisfactorily. Previous notes in this Journal have emphasized the importance of suitable varieties—such as Red Marvel—for this purpose, especially where it is impossible to sow earlier than the middle of February.

Another operation which may well be carried out, when February is not a wet month, is manuring and cross ploughing for roots. Heavy land is considerably improved by a timely re-ploughing, and the application of yard manure at this stage, instead of in the drills at seeding time, is generally sound practice and good management.

The advice, given last year, to sow beds of marrow stem kale and kohl rabi in February, for transplanting in April and May, will bear repetition, especially as a reminder to farmers who wish to have kale ready for July or August feeding—in the event of a dry summer.

Varieties of Spring Oats.—The best-known variety of spring oats is Abundance, and many farmers believe it is still the heaviest yielder on average good land. That it is one of the best varieties may be freely admitted, but the results of recent trials indicate that there are now other varieties of superior merit. The comparative yields at three provincial stations and at an additional centre in Yorkshire in 1925 were as follows :—

	Norfolk	Sutton Bonington	Garforth New Seed	Garforth Seed once grown	Great Smeaton
Abundance ..	100	100	100	100	100
Golden Rain ..	108	..	113	105	112
Victory ..	102	85	123	118	120
King	..	..	116	115	118
Crown ..	..	..	94	98	107

In the Devonshire experiments, of which there were three in 1925, the yields of Abundance were excelled to an even greater extent by Golden Rain and Victory. The results of the trials in that county, however, contrast strongly with those of the Yorkshire trials in the behaviour of Crown, which proved about the heaviest yielder in Devonshire. The averages for the three experiments were: Abundance 100, Crown 131, Golden Rain 129, Victory 122, Black Tartarian 107. The last mentioned variety is believed to be of special value for poor upland districts; but it is difficult to find the results of any experiment, whether on good or on poor soil, where Black Tartarian has not been excelled in yield by other sorts.

Varieties of Barley.—The difference in value between one grade of barley and another is greater than that between various grades of wheat or oats. Good samples of wheat or oats are, of course, more easily sold than inferior samples, but there is no special demand for the superior qualities comparable with that which exists in the case of barley. The best malting samples of barley, however, may be worth double the price of ordinary feeding grain, hence the grower's interest in the respective malting qualities of different varieties.

Certain sorts, such as the four-rowed, the six-rowed and Spratt, may be described as producing grain that ordinarily cannot be sold for malting, but, unfortunately, it is not possible to be very simple and specific in the description of the malting qualities of the ordinary spring varieties; the influence of soil and season must be considered in relation to the habits of the variety. For example, Archer, a late-ripening variety, may produce good, well-filled grain under conditions that favour early and complete ripening, *viz.*, rather dry poor soils; to some extent this also applies to Spratt-Archer, which is not an early sort. On the other hand Svalöf Gold, a very early-ripening kind, may fail to fill properly when grown under dry, poor conditions; and the same applies in some measure to Plumage-Archer, which is a fairly early sort. Whether the variety is strong or weak in the straw, may be a deciding factor in another set of conditions; but this property is not

such a constant variety characteristic as is sometimes assumed As a rule Plumage-Archer and Spratt-Archer stand well.

The yielding properties of different sorts are also dependent on conditions, some of which may be inferred from the above remarks. The following results from four experiments carried out in 1925 may, however, be of interest in this connexion. The yields are compared with Plumage-Archer :—

	Norfolk	Sutton Bonington	Garforth	Malton
Plumage-Archer	100	100	100	100
Spratt-Archer	115	123	100	101
Beaven's Archer	105	—	—	—
Sunrise ..	99	—	—	—
Archer Goldthorpe ..	94	—	—	—
Burton Malting	—	107	—	—
Gold	—	—	117	87

Pig Keeping.—The supply of store pigs is usually at its lowest point in January and February, after which, with the arrival of litters in these months, especially February, the numbers offered gradually increase, the maximum being reached about May. During the past year there has been keen demand for stores, and high prices have ruled, feeders having realized that the relative prices of pig meat and feeding stuffs have been such as to allow a margin of profit.

Although the numbers of pigs shown in the official statistics do not indicate it, there is undoubtedly a growing interest in pig production in this country, and as is shown in one of the Ministry's publications* there is considerable room for expansion in the direction of producing pigs of the right kind and size for the British bacon factories. Readers interested in that pursuit may be referred to the above-mentioned booklet and to the paper read by Lord Bledisloe at the December meeting of the Farmers' Club.

In some parts of the country, particularly the industrial districts of the midland and northern counties, there is a limited market for pigs of much heavier weights than those of 140 to 180 lb. carcass, suitable for the Wiltshire-side trade. Midland curers hitherto preferred pigs of about 200 lb. dead weight, from which they cut off the hams, sold the back as pork and cured the sides for bacon, but it is interesting to note that they now pay top prices for pigs of the weights required by the Wiltshire side trade. In some cases pigs, yielding as much as 280 lb. of carcass, are saleable, but the very heavy hams (35 lb.) cut from such pigs are not in demand, and the buyer has to allow for

* *The Marketing of Pigs*, Economic Series No. 12, H.M. Stationery Office, Kingsway, W.C. 2, Price 6d. Post free 9d.

this in his purchase price. The question that naturally arises here is whether it is more profitable, where large pigs can be sold, to feed to such heavy weights instead of having a more rapid turnover of numbers sold at smaller sizes.

In agricultural literature, it is generally assumed that there is a simple and clear case against the large pig, on the ground that he is a less efficient food-transformer than the small pig. Innumerable experiments have demonstrated that the amount of food required to produce 1 lb. of *live weight* gain increases with the size of the pig. Nevertheless, there are many experienced feeders who believe that the fattening pig pays best during the later stages. It was a recent lengthy discussion of the subject with a butcher, who also feeds about 3,000 pigs a year and who adheres to the said belief, that caused the writer to endeavour to throw light on the matter. The results of this endeavour (which are contrary to what was expected) are set forth in the following tables. The nutrition data in Table I are based on Hansson's results; and the estimates of dressed carcass in Table II are based on the figures quoted on page 78 of *Marketing of Pigs*. It is important to note that the higher percentage *yield of carcass* in the heavier pig is sufficient to outweigh the disadvantage of his greater food consumption per pound of live weight increase.

TABLE I.—COST OF FOOD

Live weight of pig. lb.	Food per lb. live weight gain	Food consumed in period	Cost of food at £9 6s. 8d. per ton Period		Total		
			s.	d.	£	s.	d.
35—75	3·64	145	12	1		12	1
75—115	4·00	160	13	4	1	5	5
115—155	4·33	173	14	5	1	19	10
155—195	4·60	184	15	4	2	15	2
195—235	4·80	192	16	0	3	11	2
235—275	4·98	199	16	7	4	7	9
275—315	5·15	206	17	2	5	4	11

TABLE II.—VALUE OF CARCASS

Live weight of pig lb.	Estimated dressed carcass lb.	Food per lb. of carcass	Value at 10d. per lb.			"Profit" or Loss — On period		Total			
			£	s.	d.	s.	d.		£	s.	d.
75	46	6·0	1	18	4			—		13	9
115	73	5·9	3	1	1			—		4	4
155	105	5·5	4	7	6					7	8
195	139	5·2	5	15	10	13	0		1	0	8
235	175	5·3	7	5	10	14	0		1	14	8
275	214	5·0	8	18	4	15	11		2	10	7
315	255	5·1	10	12	6	17	0		3	7	7

The lesson to be drawn from the above table is that, with store pigs at £2 per head, meals at 1d. per pound and flesh at 10d. per lb., there is no "profit" at all until the pig reaches about 90 lb. carcass weight. With pork at 1s. 1d. per lb., however, there is a margin of about £1. It was also shown that the most profitable feeding period is the later stages, provided always that the price per pound of flesh is the same. With meals at a price higher than 1d. per pound, the loss in the early stages would be increased, unless compensated by a lower cost of the store pig.

* * * * * *

NOTES ON MANURES FOR FEBRUARY

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Spring Requirements.—At this season of the year it is advisable to make an estimate of the fertilizer requirements for the coming months, so that the necessary manures may be on the farm in time for the period of spring activity. The scheme will be somewhat as follows, although it must be modified in detail to suit special conditions :—

(1) *Winter Cereals.*—When there is reason to believe that only nitrogen is necessary and that the nature of the soil and climate is not likely to lead to lodging, the winter corn will require about 1 cwt. of sulphate of ammonia per acre.

(2) *Grass Land.*—Where a very early bite is required, or it is important to produce bulk in the hay crop, the grass may receive the same quantity of quick-acting nitrogen as in the case of winter corn. This treatment will not be necessary if dung or cyanamide has been given in the previous autumn.

(3) *Spring Corn.*—Other than that which follows roots or good ley, the spring corn will probably require a light dressing of artificials; say, 2 cwt. of superphosphate, 1 cwt. of sulphate of ammonia, with the addition of ½ cwt. of muriate of potash on the lighter soils.

(4) *Roots.*—Assuming that these crops will receive farmyard manure, we can reckon their minimum requirements as follows :—POTATOES : 4 cwt. superphosphate, 1½ cwt. sulphate of ammonia, 1 cwt. sulphate of potash per acre. MANGOLDS AND SUGAR BEET : 4 cwt. superphosphate, 1 cwt. sulphate of ammonia, 1 cwt. muriate of potash, and 1 cwt. nitrate of soda per acre. SWEDES : 4 cwt. superphosphate, and where large crops are normally grown 1 cwt. sulphate of ammonia and 1 cwt. muriate of potash in addition.

In the above outline the approximate requirements have been stated for the most part in terms of superphosphate, sulphate of ammonia and muriate of potash, but equivalent quantities of phosphate, nitrogen, and potash supplied in other forms will often be chosen for reasons arising out of local conditions.

At present, when many farmers are short of working capital, there is naturally a tendency to reduce expenditure all round, and the outlay on fertilizers comes under careful review. A case may be made for reducing the dressings where the rate of application has been heavy and prices are falling. Under the more usual conditions of light or medium dressings, to cut down the consumption of fertilizers is a doubtful economy, for, although they must be used with knowledge and their effects are dependent on the weather, in the long run their use is profitable.

Phosphate and Potash to Growing Crops.—There is no doubt that phosphatic and potassic manures are best applied to autumn-sown crops before drilling, for by this method the fertilizing constituents are distributed where they are most needed, *i.e.*, in the region searched by the roots of the young plants. There is, moreover, no risk of either of these classes of manures being washed out of the soil before the crop can utilize them. It occasionally happens, however, that for some reason it has not been possible to give the necessary phosphate and potash to winter-sown crops when preparing the seed bed, and the question then arises whether anything can be done to remedy matters in the spring. In dealing with cases of this kind, the guiding principles should be to give the dressing in water-soluble form, by using superphosphate and any potash salt, to apply the manures as early as possible, and to incorporate the dressing with the harrows as thoroughly as the condition of the corn will allow.

Top-dressing Cereals.—A few points in connexion with the use of top dressings for cereals may be mentioned. The manures should preferably be water-soluble, so that no incorporation with the soil is required and very little moisture will bring them into action. Nitrates and salts of ammonia will therefore be given preference over cyanamide or organic nitrogenous manures. Although cases are on record in which top dressings applied as late as the middle of May have been highly successful, most experience is in favour of making the application as soon as conditions will permit the steady growth of cereals.

Dressings given in the form of sulphate of ammonia may be applied with safety earlier than nitrates, for, in cold weather, when crops are standing still, the ammonium salts are well retained by the soil. If land is in need of general manuring, nitrogenous fertilizers will not produce their full effect, and the bad reputation which nitrate of soda and sulphate of ammonia still possess among certain farmers is chiefly due to their use on land which had been stinted of phosphate and potash. For most circumstances about 1 cwt. of sulphate of ammonia or nitrate of soda per acre will be sufficient. A mixture of equal weights of both forms has some advantages; the acid effect of the ammonium salt is to some extent counteracted by the soda left behind from the nitrate, and the mixture provides nitrogen in two stages of availability. Larger quantities must be used with caution, as the tendency of nitrogen is to increase the straw in relation to the grain, to delay ripening, and to favour lodging. In wet districts and on rich soils, where cereals make much straw and are liable to go down before harvest, it is usual to avoid nitrogenous dressings and to rely more on phosphatic treatment, which counteracts rankness and helps maturity.

Compound Fertilizers.—The question often arises, whether farmers are better advised to purchase ready-made compound manures or to obtain the simple fertilizers separately and mix them on the farm. In favour of the compound manures we may say that the mixing, being carried out by machinery, will be more thoroughly done than would be possible on the farm; and that the condition of the mixtures will be good in view of the manufacturers' ability to avoid the difficulties which sometimes arise when fertilizers are brought together. The separate ingredients can also be purchased by the trade in wholesale quantities and, therefore, at more favourable rates than by the small buyer. Moreover, the fact that ready-mixed fertilizers mean a saving of time and labour on the farm at a busy season is a real consideration.

On the other hand, it is maintained that, provided the farmer has a good knowledge of the use of fertilizers, he will be in a better position to judge of the special needs of his fields and crops than an outside firm; he can then either have his own mixtures made up by the manufacturer, or, if he follows a few rules as to the mixing of manures, he may make his own compounds from the cheapest and most suitable constituents,

thereby saving the charges made by the trade for mixing and bagging. Further, information may be required about a ready-made mixture which is not necessarily supplied on the invoice; for example, such questions as whether nitrogen is present as readily available compounds or as less available organic substances, or whether the potash is supplied as low-grade or as high-grade salts. No doubt, the tendency will be to give more information as to the constituents of compound manures than is done at present.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending January 12				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	..	13 5	13 0	13 5	17 1
Sulphate of ammonia—					
Neutral (N. 20·6%)	12 0*	12 0*	12 0*	12 0*	11 8
Calcium cyanamide (N. 19%) ..	9 12*	9 12*	9 12*	9 12*	10 1
Kainit (Pot. 14%)	3 2	2 17	2 17	2 15	3 11
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	3 12	3 2	3 9	3 2	3 1
Muriate of potash (Pot. 50-53½%)	9 10	8 2	8 13	9 7	3 6
Sulphate „ (Pot. 48-51½%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 30%)	..	3 2§	8 3§	3 6§	2 2
„ (T.P. 28%)	..	2 11§	2 19§	..	..
„ (T.P. 26%)	..	2 7§	2 15§	..	..
„ (T.P. 24%)	..	2 2§	..	2 11§	2 1
Ground rock phosphate (T.P.58%)	2 10¶	..	..	2 12¶	0 11
Superphosphate (S.P. 35%) ..	3 11	..	3 9	3 10	2 0
„ (S.P. 33%) ..	..	..	3 6	..	..
„ (S.P. 30%) ..	3 5	2 15	3 2	3 3	2 1
Bone meal (N. 3½%, T.P. 45%) ..	8 15	8 5	8 10	8 0	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 0†	6 10†	6 0	5 15	..
Burnt lump lime	2 0	1 12a	2 0b	2 1c	..
Ground lime	2 7	2 1a	2 9b	1 15c	..
Ground limestone	..	..	1 10b	..	..
Ground chalk	..	1 9	..	1 5c	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

¶ Fineness 80% through standard screen of 10,000 holes to the square inch. Price at London is for 4-ton lots f.o.r. at Northern London Stations, and at G.W.R. and S.R. London Stations the cost to purchasers is 55s. per ton. For the finer grade (80% through standard screen of 14,400 holes to the square inch) the price at London is 2s. 6d. per ton more than for the coarser grade.

a Delivered to Hull.

b Delivered to Liverpool area.

c Delivered in 4-ton lots to London.

The chief objection to the use of ready-mixed fertilizers has been based on instances of excessive charges for the actual plant food supplied, which have come under notice from time to time. This risk can be avoided by dealing with reputable firms. A rough estimate can be made of the charge for compounding a mixture by valuing its nitrogen, soluble phosphate, insoluble phosphate, and potash as declared in the analysis at the rates per unit at which these elements of plant food can be obtained at the farmer's station as sulphate of ammonia, superphosphate, steamed bone flour and potash salts respectively—bearing in mind, however, that insoluble phosphate may be supplied in part as ground rock phosphate at about half the unit price of steamed bone flour. In dealing with manures, careful observation of their effects and study of their properties, helped out where necessary by the advice of the county agricultural staffs, can be regarded as the most satisfactory procedure. For those who, for some reason, cannot adopt this course, high-grade mixed fertilizers form an alternative. They should be obtained from a trustworthy firm having good acquaintance with local conditions.

NOTES ON FEEDING STUFFS FOR FEBRUARY

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The Hygienic Principles of Feeding.—The necessity for the provision of pure, wholesome food, if the health of the nation is to be maintained, has long been recognized. Governments, realizing that the motto "*Caveat emptor*" was insufficient to protect the public in this direction, have from time to time promoted legislation to ensure that the producer and distributor should take all reasonable precautions in order that the food supplied should be a pure and clean product. In the case of farm animals, such feeding-stuff laws that exist only ensure that the feeding stuff shall be of a definite composition, and that it shall be true to description. The farm animal is therefore at the mercy of its owner, in so far as the wholesomeness and cleanliness of its food supply is concerned, and, being a dumb animal, the only effective protest it can make against an unwholesome food supply, is to die.

Deaths from food poisoning in farm stock are more common than they should be, and, owing to the costliness of litigation and the effect on subsequent sales of any legal action of this character, the feeding-stuff manufacturer whose product is blamed for the death of the animal will often prefer to compensate the farmer rather than resist the claim. This is, perhaps, unfortunate, since it favours the perpetuation of the uncleanly conditions of feeding that, in certain cases, are primarily responsible for the deaths in question. That such a possibility does exist is illustrated by a case of suspected food-poisoning of pigs that was recorded in a veterinary journal. On a certain farm several pigs suddenly died after consuming a ration consisting of boiled potatoes and mixed meals. Post-mortem examination revealed the fact that the stomachs of the animals were severely inflamed, and the appearances indicated the presence of an irritant poison. Chemical examination of the stomach contents and the foods fed gave negative results, and it was only through a casual conversation at a later period that the true cause of the deaths was ascertained. It had happened that the person responsible for the feeding of the pigs was in a hurry to get away to a social engagement, and, in order not to be late, mixed the potatoes with the meal before they were properly cool. The result was that the pigs consumed potatoes whose interiors were scalding hot, and these potatoes were responsible for the inflammation and deaths caused.

In another case a manufacturer of a proprietary meal or cake was asked for compensation for illness to stock caused by feeding stuffs, but fortunately he insisted on a thorough investigation into the conditions of feeding before assuming liability. It was found that the farmer had bought a large quantity of wet brewers' grains, which he was still feeding some months after purchase, although he had taken no precautions to ensure that the grains should be kept in a sweet, wholesome condition. In this case the grains in question were semi-putrid and swarming with living organisms of a microscopic nature, and it was clear that the illness was caused through the farmer's own neglect.

These two cases clearly demonstrate that some farmers, at least, do not even yet recognize the necessity of taking every precaution to ensure that the foods when purchased are in a sound, wholesome condition, and of taking care to keep them in a sound, wholesome condition until and when they are fed to the animal. Most farmers who read this article

Description	Price per qr.			Price per ton		Manurial value per ton		Cost of food value per ton		Starch equiv. per 100 lb.	Price per unit starch equiv.		Price per lb. starch equiv.	Protein equiv.
	s.	d.	lb.	£	s.	£	s.	£	s.		s.	d.	d.	%
Wheat, British..	—		—	12	0	0	14	11	6	72	3	2	1·70	9·6
Barley, British feeding ..	—		—	8	15	0	11	8	4	71	2	4	1·25	6·2
„ Californian feed ..	32	6	400	9	2†	0	11	8	11	71	2	5	1·29	6·2
„ Argentine	33	9	„	9	8	0	11	8	17	71	2	6	1·34	6·2
„ Danubian	32	0	„	8	18*	0	11	8	7	71	2	4	1·25	6·2
„ Persian	30	6	„	8	10	0	11	7	19	71	2	3	1·20	6·2
„ Russian	34	9	„	9	15	0	11	9	4	71	2	7	1·38	6·2
Oats, English, white	—		—	9	7	0	12	8	15	60	2	11	1·56	7·6
„ „ black and grey	—		—	8	17	0	12	8	5	60	2	9	1·47	7·6
„ Scotch white	—		—	10	0	0	12	9	8	60	3	2	1·70	7·6
„ Irish black	—		—	8	15	0	12	8	3	60	2	9	1·47	7·6
„ Canadian feed	24	9	320	8	13*	0	12	8	1	60	2	8	1·43	7·6
„ American	22	9	„	8	0‖	0	12	7	8	60	2	6	1·34	7·6
„ Argentine	24	0	„	8	8	0	12	7	16	60	2	7	1·38	7·6
„ Chilian	25	0	„	8	15	0	12	8	3	60	2	9	1·47	7·6
Maize, Argentine	33	6	480	7	17	0	11	7	6	81	1	10	0·98	6·8
Beans, English winter.. ..	—		—	10	5	1	10	8	15	66	2	8	1·43	20
Peas, English blue	—		—	17	0*	1	6	15	14	69	4	7	2·45	18
„ Japanese	—		—	28	5†	1	6	26	19	69	7	9	4·15	18
Dari, Bombay	—		—	12	5	0	14	11	11	74	3	1	1·65	7·2
Rye, homegrown	—		—	9	5	0	14	8	11	72	2	5	1·29	9·1
Millers' offals—														
Bran, British	—		—	7	5	1	5	6	0	42	2	10	1·52	10
„ broad	—		—	8	5	1	5	7	0	42	3	4	1·78	10
Middlings, fine, imported ..	—		—	9	5	1	0	8	5	69	2	5	1·29	12
„ coarse, British ..	—		—	7	7	1	0	6	7	58	2	2	1·16	11
Pollards, imported	—		—	6	12	1	5	5	7	60	1	9	0·94	11
Meal, barley	—		—	10	7	0	11	9	16	71	2	9	1·47	6·2
„ maize	—		—	9	12	0	11	9	1	81	2	3	1·20	6·8
„ „ germ	—		—	9	0	0	18	8	2	85	1	11	1·03	10
„ „ gluten feed ..	—		—	8	15	1	5	7	10	76	2	0	1·07	19
„ locust bean	—		—	9	5	0	9	8	16	71	2	5	1·29	3·6
„ bean	—		—	12	10	1	10	11	0	66	3	4	1·78	20
„ fish	—		—	22	0	3	18	18	2	53	6	10	3·66	48
Maize, cooked flaked	—		—	10	5	0	11	9	14	85	2	3	1·20	8·6
Linseed—														
„ cake, English, 12% oil	—		—	12	12	1	15	10	17	74	2	11	1·56	25
„ „ „ 10% „	—		—	12	5	1	15	10	10	74	2	10	1·52	25
„ „ „ 9% „	—		—	11	17	1	15	10	2	74	2	9	1·47	25
Soya bean „ 6% „	—		—	12	0*	2	9	9	11	69	2	9	1·47	36
Cottonseed cake, English, 5½%„	—		—	6	7	1	12	4	15	42	2	3	1·20	17
„ „ Egyptian, 5½% „	—		—	6	0	1	12	4	8	42	2	1	1·12	17
Decorticated cottonseed meal, 7% oil	—		—	8	15	2	9	6	6	74	1	8	0·89	35
Coconut cake, 6% oil	—		—	9	0	1	9	7	11	79	1	11	1·03	16
Ground-nut cake, 6% oil ..	—		—	7	17	1	13	6	4	57	2	2	1·16	27
Decorticated ground-nut cake, 7% oil	—		—	11	15*	2	11	9	4	73	2	6	1·34	41
Palm kernel cake, 6% oil ..	—		—	7	10†	1	1	6	9	75	1	9	0·94	17
„ „ „ meal, 6% oil	—		—	9	10*	1	1	8	9	75	2	3	1·20	17
„ „ meal, 2% oil ..	—		—	7	5*	1	2	6	3	71	1	9	0·94	17
Feeding treacle..	—		—	6	0	0	9	5	11	51	2	2	1·16	2·7
Brewers' grains, Dried ale ..	—		—	7	7	1	2	6	5	49	2	7	1·38	13
„ „ „ porter ..	—		—	6	17	1	2	6	15	49	2	9	1·47	13
„ „ Wet ale ..	—		—	1	3	0	8	0	15	15	1	0	0·54	4·8
„ „ „ porter ..	—		—	0	18	0	8	0	10	15	0	8	0·36	4·8
Malt culms	—		—	7	0†	1	12	5	8	43	2	6	1·34	16

Prices at London except where otherwise stated.
* At Hull. † At Liverpool. ‖ At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of December and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 11s. 8d. P_2O_5, 3s. 8d.; K_2O, 3s. 0d.

will say, at this stage, "Yes, but I always take care to feed my stock with the best food, and to feed it in a cleanly condition." In order to ensure that such is the case, perhaps it would be well if all farmers would ask themselves the following questions :—

(1) Do I ever purchase parcels of cake or meal at a reduced price owing to a minor fault, *i.e.*, slight mouldiness or mustiness ?

(2) Do I take care to get my hay in in good condition, and do I take care to see that the ricks are weathertight ?

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows :—

	Starch equivalent	Protein equivalent	Per ton
	Per cent.	Per cent.	£ s.
Barley	71	6·2	9 2
Maize	81	6·8	7 17
Decorticated ground nut cake	73	41·0	11 15
" " cotton cake	71	34·0	10 0

(Add 10s. per ton, in each case, for carriage)

The cost per unit starch equivalent works out at 2·20 shillings, and per unit protein equivalent, 1·83 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	8 16
Oats	60	7·6	7 6
Barley	71	6·2	8 7
Potatoes	18	0·6	2 1
Swedes	7	0·7	0 17
Mangolds	7	0·4	0 16
Beans	66	20·0	9 2
Good meadow hay	31	4·6	3 17
Good oat straw	17	0·9	1 19
Good clover hay	32	7·0	4 3
Vetch and oat silage	13	1·6	1 11
Barley straw	19	0·7	2 3
Wheat straw	11	0·1	1 4
Bean straw	19	1·7	2 5

(3) In feeding stored roots, do I insist on all unsound roots being rejected, or do I pulp them with the others on the ground that they are not likely to hurt ?

(4) Do I periodically inspect all feeding troughs, bins, etc., to make sure that they are thoroughly clean and that no food residues from previous feeds are left in to cake at awkward corners ?

(5) Is my food store dry and damp-proof, and have I provided a cement mixing floor that can be easily cleaned ?

(6) Do I stack my concentrated cakes in such a way that air can freely circulate and keep them in a dry condition, or is each lot just dumped down anyhow when it arrives on the farm ?

(7) Do I see that the stockmen exercise cleanliness and care in the preparation, feeding, and mixing of rations, or do I just tell them what to do and assume they do it ?

If the reader can answer all these questions satisfactorily, then he may assume that the article is not written for him ; if not, then it is hoped that he will endeavour to alter his system so that in the future he will be able to do so.

MISCELLANEOUS NOTES

Short Course for Milk Recorders

A SPECIAL Course in Milk Recording will be held at the University College, Reading, from February 22, 1927, to March 12, 1927. Each day's instruction will embrace :—

(*a*) At least two hours' theoretical teaching.

(*b*) Practical work in weighing, sampling, testing and the keeping of milk records.

Applicants must be able to milk before admission to the Course.

At the conclusion of the Course the authorities of the University College, Reading, will notify in writing those students who have satisfied their instructors as to their industry and general ability and who have passed both the theoretical and practical examinations held during the closing days.

SYLLABUS

(*a*) *Lecture Course*

(1) *Milk.*—Nature and composition ; causes of variation ; Food and Drugs Act ; regulations concerning milk.

Bacteria.—Milk as a medium for bacteria; control of bacterial growth, importance of cleanliness; use of preservatives; the Milk and Dairies Act.

Testing.—Weighing, methods of sampling; simple and composite samples; determination of the percentage of fat, and of the specific gravity; the Gerber test; the lactometer, calculation and percentage of total solids from percentage of fat and specific gravity; calculation of averages.

(2) The principles and practice of milk recording; the Ministry of Agriculture Scheme; why accuracy in detail is essential; discussion of the duties of recorders, with a study of the forms which must be kept; milk record certificates and register of dairy cows; interpretation of milk records; calculation of herd averages; breed societies, records and registers of merit; marking of cows; calf and bull marking scheme; methods of keeping food records.

(*b*) *Practical Work*

Actual milk recording; the taking of simple and composite samples under various conditions; determination of the percentage of fat (Gerber method) and the specific gravity; calculation of total solids; use of the Richmond scale; visits to farms evening and morning to weigh milk and make the necessary entries; checking of records; detection of errors and abnormal results; keeping of food records, and calculation of cost of feeding and cost of food per gallon of milk.

The tuition fee for the Course will be £3. The College registration fee of 1s. must also be paid.

Board and residence are obtainable in the neighbourhood of the College, at rates varying from £1 15s. to £2 5s. per week, and addresses where such lodgings may be obtained will be sent on the applicant's request.

Applications for admission to the Course should be made not later than Thursday, February 17, 1927, to the Dean, Faculty of Agriculture and Horticulture, The University, Reading.

Students are advised to bring cycles with them if possible, as some of the work will necessitate frequent visits to the College Farm.

Growers of Certified Stocks of Potatoes in 1926

DURING the past season, Inspectors of the Ministry of Agriculture and Fisheries have examined many fields of growing crops of potatoes of varieties which have been approved as immune from Wart Disease, with a view to the certification of the crops under the Wart Disease of Potatoes Order of 1923 as being true to type and reasonably free from rogues. A list of the growers of these certified stocks has been prepared and copies may be obtained, price 1s., from the

Ministry, who will also be happy to supply on application the names and addresses of growers of certified stocks of any particular variety, together with the numbers of the relative certificates.

Growers are reminded that the only potatoes which may be planted on land infected with Wart Disease are those from crops which have been so certified.

The list also includes the names and addresses of growers of varieties not approved as immune from Wart Disease whose crops were inspected while growing and found to be true to type. The importance of planting true stocks is becoming better realized by potato growers, and the extension of the system of inspection to non-immune varieties has, it is believed, proved to be of material assistance both to growers and purchasers of seed potatoes.

The Agricultural Index Number

DURING December the general level of the prices of agricultural produce receded two points from the position held in October and November, and at 46 per cent. above pre-war was lower than at any time since the war, and eight points below the figure of 54 per cent. shown in December, 1925. Although a few commodities, notably fat cattle, fat and store sheep and poultry, appreciated slightly in price during the month, the general tendency was one of decline both in price and index number.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1921:—

	Percentage Increase compared with the Average of the corresponding month in 1911-13					
Month	1921	1922	1923	1924	1925	1926
January	180	71	67	60	71	58
February	164	75	63	61	69	53
March	146	73	59	57	66	49
April	145	66	54	53	59	52
May	115	69	54	57	57	50
June	105	64	49	56	53	48
July	103	67	50	53	49	48
August	122	68	52	57	54	49
September	113	59	52	61	55	55
October	82	61	50	66	53	48
November	74	63	51	66	54	48
December	71	61	55	65	54	46

Live Stock

Fat cattle appreciated slightly in price during December, the average being raised towards the end of the month on account of the Christmas sales to 46s. per live cwt. As, however, there was a relatively larger rise in the base years, the percentage increase above pre-war prices fell from 31 per cent. in November to 28 per cent. in December, bringing the index figure to 16 points below the level of December, 1924 and 1925. The average price of fat sheep also increased to 11½d. per lb. estimated dressed carcass weight owing to the better seasonal demand, and at 44 per cent. above the base years the December figure was one point higher than in the previous month and only three points lower than in December, 1925. Fat pigs depreciated in price during the latter part of December, and on the average baconers were 7d. and porkers 4d. per 14 lb. stone estimated dressed carcass weight cheaper than in November, while the index figures were eight and four points lower at 63 and 72 per cent. above pre-war respectively. During the month under review baconers were 1s. 7d. and porkers 11d. per 14 lb. stone cheaper than in the previous December, when the relative index figures were 86 and 84 per cent. above the level of 1911-13. Store stock, with the exception of store sheep, which showed a slight increase in price, were cheaper than in November. A slight decline in the price of store cattle caused the index figure to fall one point to 21 per cent. above pre-war, while dairy cattle, which showed a fall of about 15s. per head, were four points lower at 30 per cent. above the level of the base years. Store sheep were approximately 3s. per head dearer in December than in the previous month, but as a relatively larger increase in price occurred in the corresponding period of the base years the index figure moved one point lower to 41 per cent. above pre-war. The index number for store pigs in December showed the considerable fall of 20 points on the month, but in this case there was a reverse movement in the corresponding months of the base years, so that the fall of 3s. 6d. per head from the price in November was not the sole cause of the decline in the index figure.

Grain

Wheat at an average of 11s. 10d. per cwt. was 7d. cheaper in December than in the previous month, and the index figure was correspondingly lower, declining from 66 per cent. above pre-war in November to 61 per cent. for the month under review, and at this level it was six points lower than in December, 1924 and 1925. Barley also showed a reduction on the month,

the average price falling 8d. per cwt. to 10s. 10d. per cwt., and at this figure it was 31 per cent. above the level of 1911-13 and two points higher than a year ago, but considerably below the level of December, 1924, when it was 76 per cent. above pre-war. The average price of oats was 3d. per cwt. less than in November, when this cereal averaged 8s. 5d. per cwt., and the relative index number shows a fall of 3 points to 17 per cent. above the level of the base years, or 15 points lower than a year ago.

Dairy and Poultry Produce

Milk was very slightly dearer than in November, and the index figure is one point higher at 65 per cent. above pre-war. Butter was a little cheaper, and a decrease of seven points brought the index figure to 40 per cent. above the level of 1911-13 and 28 points below the figure for the previous December. Cheese, on the other hand, was slightly dearer, but as a similar movement in price took place in the corresponding month of the base years the index figure remained unchanged at 28 per cent. above pre-war. Eggs, as anticipated at this season of the year, showed a considerable decline in price from 2s. 10d. to 2s. 5½d. per dozen, and the index figure fell 14 points to 46 per cent. above the pre-war price as compared with the figure of 74 per cent. in December, 1925, and 51 per cent. in December, 1924. Poultry showed the usual seasonal appreciation in price during the month, but as there was a proportional increase in the base years the index number remained unaltered at 49 per cent. above pre-war.

Other Commodities

Potato prices remained very steady during December, and the index figure dropped only three points from the high level of 113 per cent. above the base years which was registered in the previous month, and at this level they were the dearest agricultural produce dealt with in arriving at the general index figure. Prices of hay varied little from those ruling in November, but the changes were sufficient to depress the index figure another two points to the level of only 2 per cent. above the base years 1911-13. Wool was slightly cheaper, and the decline of ⅛d. per lb. is reflected in the index number, which fell two points to the rather low level of 29 per cent. above pre-war. Little English fruit was on the market during December and vegetables showed very little variation from the November prices.

Index numbers of different commodities during recent months and in December, 1924 and 1925, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1924	1925	1926			
	Dec.	Dec.	Sept.	Oct.	Nov.	Dec.
Wheat	67	67	50	53	66	61
Barley	76	29	50	42	35	31
Oats	37	32	25	17	20	17
Fat cattle	44	44	39	35	31	28
Fat sheep	84	47	52	52	43	44
Bacon pigs	49	86	79	74	71	63
Pork pigs	49	84	81	81	76	72
Dairy cows	55	—*	39	38	34	30
Store cattle	37	—*	28	25	22	21
Store sheep	85	—*	63	47	42	41
Store pigs	38	—*	142	142	135	115
Eggs	51	74	52	68	60	46
Poultry	64	60	46	48	49	49
Milk	84	74	100	60	64	65
Butter	73	68	56	52	47	40
Cheese	51	74	34	30	28	28
Potatoes	166	64	40	81	113	110
Hay	2	4	9	6	4	2
Wool	118	49	31	32	31	29

* Very few markets for store stock were held during December, 1925, on account of foot-and-mouth disease restrictions.

* * * * * *

Foot-and-Mouth Disease.—Nine outbreaks of foot-and-mouth disease have been confirmed since the issue of the January number of the JOURNAL.

A new centre of disease was discovered at Roundway, Devizes, Wiltshire, on December 29. This brought the total number of outbreaks confirmed during the year 1926 to 204, involving 31 counties and the slaughter of 5,773 cattle, 11,671 sheep, 2,547 pigs and 11 goats.

Fresh centres of disease were also discovered on January 7 at Neasden, Middlesex, and at Rushton, Kettering, Northants. On the following day, January 8, a further fresh centre was revealed at Chalk, near Gravesend, Kent; and another outbreak in the same parish was confirmed on January 11. On January 15 disease broke out at Belper, and on January 19 at Duffield, both in Derbyshire. Fresh centres were also discovered on January 20th at Feering, Kelvedon, Essex, and at King's Newton, Derby. Eight outbreaks have, therefore, occurred during the new year, involving five counties and the slaughter of 341 cattle, 173 sheep and 291 pigs.

* * * * * *

Farm Workers' Minimum Wages.—A Meeting of the Agricultural Wages Board was held on December 21, at 7 Whitehall Place, S.W. 1, Mr. A. W. Ashby presiding in the absence of Lord Kenyon.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and

proceeded to make the following Orders carrying out the Committees' decisions :—

Cambridgeshire and Isle of Ely.—An Order continuing with certain minor amendments in the case of boys from January 1, 1927, until February 28, 1927, the existing minimum and overtime rates of wages for male and female workers. The minimum rate in the case of male workers of 21 years of age and over employed wholly or mainly as horsemen, cowmen or shepherds is 37s. per week for the hours necessary for the performance of the customary duties of workers so employed, and in the case of other male workers of 21 years of age and over, 30s. per week of 48 hours with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays. In the case of female workers of 18 years of age and over, the minimum rate is 5½d. per hour with overtime at 7d. per hour.

Derbyshire (a)—An Order continuing from December 26, 1926, until December 25, 1927, the existing minimum and overtime rates of wages for male and female workers. The minimum rates in question are for male workers of 21 years of age and over, 8d. per hour on weekdays for a guaranteed week of 54 hours with overtime at 10d. per hour for Sunday work, and in the case of female workers of 18 years of age and over, 5d. per hour on weekdays with overtime at 8d. per hour for Sunday work.

(b) An Order fixing special differential rates of wages for overtime employment of male workers of 18 years of age and over on harvest work in the hay and corn harvests, 1927. The rate in the case of male workers of 21 years of age and over is 9d. per hour.

Middlesex.—An Order continuing from January 26, 1927, until February 29, 1928, the existing minimum and overtime rates of wages for male and female workers. The minimum rates in the case of male workers of 21 years of age and over are 41s. 3d. per week of 60 hours in the case of stockmen, 38s. 6d. per week of 56 hours for carters, 34s 4½d. per week of 50 hours in summer, and 33s. per week of 48 hours in winter for all other wholetime workers, and 8¼d. per hour for casual workers with overtime in each case at 10½d. per hour. For female workers of 18 years of age and over, the minimum rates are 30s. per week of 60 hours in the case of such workers employed on the duties of stockmen, 28s. per week of 56 hours for carters, 25s. per week of 50 hours in summer and 24s. per week of 48 hours in winter for all other wholetime workers, and 6d. per hour for casual workers with overtime at 7½d. per hour in all cases.

Norfolk.—An Order continuing from January 1, 1927, until June 1, 1927, the existing minimum and overtime rates of wages for male and female workers. The minimum rate in the case of male workers of 21 years of age and over is 30s. per week of 50 hours in summer and 48 hours in winter with overtime at 9d. per hour on weekdays and 11d. per hour on Sundays, with, in the case of workers employed as teamsmen, cowmen, shepherds, or yardmen, 5s. 6d. per week in lieu of overtime in respect of work in connection with animals, and in the case of sheep-tenders and bullock-tenders 4s. 6d. per week. The minimum rate in the case of female workers of 18 years of age and over is 5d. per hour with overtime at 6½d. per hour on weekdays and 7½d. per hour on Sundays.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

Enforcement of Minimum Rates of Wages.—During the month ending January 15 legal proceedings were instituted against five employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture. Particulars of the cases are as follows :—

County	Court	Fines	Costs	Arrears of wages	Workers concerned
		£ s. d.	£ s. d.	£ s. d.	
Notts ..	Newark	0 2 0	—	34 10 3	2
Denbigh ..	Wrexham	2 2 0	—	3 0 0	1
Derby ..	Ashbourne	—	—	3 12 0	1
Salop ..	Bridgnorth	1 0 0	—	12 12 0	3
Montgomery	Newtown	—	0 5 0	5 0 0	1

During the year 1926 proceedings were taken against 87 employers for offences under the Act, and fines amounting to £346 were imposed together with £122 costs. Arrears of wages amounting to £1,625 were recovered on behalf of 203 workers. The cases taken included five for refusing information, three for hindering officers of the Ministry in the exercise of their duties, and one for giving false information.

Retirement of the Controller of Horticulture.—Mr. W. G. Lobjoit, O.B.E., who has acted for the last 6¼ years in an honorary capacity as Controller of Horticulture at the Ministry of Agriculture, retired from that post on January 31 in order that he might be free to accept the invitation of the National Farmers' Union to become the Chairman of the Fruit and Vegetables Committee of the Union. Mr. Lobjoit has, however, agreed that his service shall be at the disposal of the Ministry in a consultative capacity for a further period of six months.

In consequence of Mr. Lobjoit's resignation, the Minister of Agriculture has appointed Mr. H. V. Taylor, M.B.E., to be the Horticultural Commissioner of the Ministry and Chairman of the Horticultural Advisory Council.

Agricultural Show in Paris.— Following the 55th International Avicultural Exhibition at Paris, from the 9th to the 14th of this month, notified in last month's issue of this JOURNAL (p. 882), the French Minister of Agriculture has decided to hold a general agricultural show in the Exhibitions Park at the Versailles Gate, in Paris, from the 14th to the 20th of next month (March). The exhibits will include breeding and fat cattle, sheep, pigs, breeding goats, fat poultry, dairy products, agricultural and horticultural products, wines, cider, perry, and spirits. As an annexe to the show, there will be a milk and butter show.

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NOTICES OF BOOKS

Crop and Stock Improvement. By A. B. Bruce, M.A., and H. Hunter, B.Sc. *Farmer and Stockbreeder* Manuals. (London: Ernest Benn, Ltd. Price 5s.)

This little book is a simply and clearly written account of the principles governing inheritance in plants and animals, principles

which go to explain the methods adopted by the older breeders and the greater measure of control that we now possess.

The old breeders worked by selection and in-breeding; why these practices answered could only be understood when Mendel's theory of unit characters became accepted, with its corollary of testing the racial purity of an individual by its progeny rather than by its ancestry.

The authors begin with the simple case of the plant, and after describing the methods of the older breeders proceed to a simple illustration of Mendel's theory, freed from the heavy terminology which, however necessary to the technical plant breeder, makes the access to the subject somewhat difficult to the farmer reader.

The authors might perhaps have emphasized the distinction between the self-fertilized plants like the cereals and the peas and the many other plants of our farms and gardens which habitually are cross-fertilized. Not only does this explain the comparative ease with which new varieties of wheat, for example, can be raised, but further it accounts for the fact that the farmer can grow on his stock of wheat or barley year after year without more than accidental deterioration, whereas he would have a difficulty in keeping his turnip seed true. There is a reference to the vigour of first crosses, but the farmer might have welcomed some discussion of the necessity or otherwise of a "change of seed" and the supposed running out of varieties.

In the discussion of animal breeding, admittedly more difficult, room might perhaps have been found for a reference to some practical points of interest to all breeders. Is improvement more easily effected by selection inside a given breed or by introducing an outcross? Again, farmers largely use first crosses for market purposes, *e.g.*, in producing bacon pigs and early maturing lambs. If the explanation of the general inferiority of second crosses is valid, what is to be said of the Scottish practice of continuing the cross with Border Leicester-Cheviot half-breds.

The authors plump strongly for the possibility of the Shorthorn as a dual-purpose breed, but are they persuaded that the milk Shorthorn, when it is fixed, will have the conformation of the beef Shorthorn?

The book is the best introduction to breeding theory that has yet appeared for the farmer or the agricultural student; we trust the authors will be encouraged to extend it by the discussion of some of the problems which are actually before the breeder to-day.

Settling in South Africa. By Admiral Sir William H. Henderson, K.B.E. (London: Charles Knight & Co., Ltd., 227-229 Tooley Street, S.E. 1. Price 6d., post free.)

A trip to South Africa last year, to visit an ex-naval officer relative, has enabled this distinguished naval officer to give a succinct account of the experiences of various ex-naval officer settlers, who accepted the retirement scheme after the war, and have taken up agricultural pursuits in the Dominion. Sir William's purpose in compiling this brochure is to help any other brother officers who may be thinking of settling in South Africa on retirement, or of placing their sons there. He has brought together a great quantity of facts and figures relating to the farms of officer settlers engaged, chiefly, in sheep and cattle raising or in growing citrus and other fruits. Useful details are given also of the approximate capital required to start in different branches of farming; of the various local training establishments in agriculture; and of the 1820 Memorial Settlers' Association, which exists to give disinterested help and advice to new settlers. Sir William emphasises the importance of intending settlers getting practical experience of

local conditions before taking up land on their own account, either by working for some time under an established farmer, or by taking at least a year's course at one of the training farms. Although intended primarily for the information of ex-naval officers who contemplate going to the Dominion, the booklet will be found very useful to anyone, with some capital, who thinks of taking up farming there.

SELECTED CONTENTS OF PERIODICALS

Agriculture, General and Miscellaneous

The Effect of Flooding with Sea Water on the Fertility of the Soil, *H. J. Page* and *W. Williams*. (Jour. Agric. Sci., XVI, 4 (Oct., 1926), pp. 551-573.) [63.11; 63.112; 63.12.]

Production and Use of Synthetic Nitrogenous Fertilisers. (Nature, vol. 118, No. 2970, Oct. 2, 1926, pp. 469-472.) [63.1671.]

Nitrogen Availability of Green Manures, *F. Löhnis*. (Soil Science, XXII, 4 (Oct., 1926), pp. 253-290.) [63.165.]

The Use of Sulphuric Acid against Weeds and Certain Crop Parasites, *E. Rabaté*. (Int. Rev. Sci. and Pract. Agric., IV (N.S.), 3 (July-Sept., 1926), pp. 535-545, plates XXV and XXVI.) [63.259; 63.295.]

Farm Bookkeeping—Cash Analysis System, *A. R. M'Dougal*. (Scottish Jour. Agric., IX, 4 (Oct., 1926), pp. 364-372.) [657.]

Field Crops

Seasonal Changes in the Composition of Winter Wheat Plants, in Relation to Frost Resistance, *R. Newton* and *W. R. Brown*. (Jour. Agric. Sci., XVI, 4 (Oct., 1926), pp. 522-538.) [63.21; 63.311.]

Yield Studies in Oats. The Effect of the Pre-Treatment of the Parent Crop upon the Seed Produced, its Germination and Subsequent Growth, *M. G. Jones* and *M. A. H. Tincker*. (Ann. App. Biol., XIII, 4 (Nov., 1926), pp. 535-559.) [63.314.]

Changes during Storage in the Composition of Mangels at the Albert Agricultural College, *J. P. Drew* and *G. T. Pyne*. (Jour. Dept. Lands and Agri. (Dublin), XXVI (1926-27), 1, pp. 9-14.) [63.332.]

Sugar Beet Growing in Scotland (Scottish Jour. Agric., IX, 3, July, 1926, pp. 304-308.) [63.3433.]

Sugar Beet Experiments, 1925. (Jour. Dept. Lands and Agri. (Dublin), XXVI (1926-27), 1, pp. 19-45.) [63.3433.]

Horticulture

The Fruit, Vegetable, and Nut Industry in the United States. Special issue of the U.S. Agriculture Year Book, 1925. [63.41 (73); 63.5 (73).]

Carbon Dioxide in Relation to Glasshouse Crops. Part III:—The Effect of Enriched Atmospheres on Tomatoes and Cucumbers, *O. Owen*, *T. Small*, and *P. H. Williams*. (Ann. App. Biol., XIII, 4 (Nov., 1926), pp. 560-576.) [63.168; 63.513.]

Flower Growing for Market in the Isles of Scilly since the Great War, *A. A. Dorrien-Smith*. (Jour. Roy. Hort. Soc., LI, 2 (Nov., 1926), pp. 266-270.) [63.5 (42); 63.522.]

Pollination in Orchards (VII). Insect Visitors to Fruit Blossoms, *G. Fox Wilson*. (Jour. Roy. Hort. Soc., LI, 2 (Nov., 1926), pp. 225-251, pl. 55-60.) [63.41 (08).]

Plant Pests and Diseases

Insects Caught in Light Traps, *F. V. Theobald*. (Jour. Roy. Hort. Soc., LI, 2 (Nov., 1926), pp. 314-323, figs. 74-77.) [63.294.]

The Lime Sulphur-Calcium Arsenate Spray, *W. Goodwin* and *H. Martin*. (Jour. Agric. Sci., XVI, 4 (Oct., 1926), pp. 596-606.) [63.295.]

The Preparation and Effectiveness of Basic Copper Sulphates for Fungicidal Purposes, *E. B. Holland, C. O. Dunbar*, and *G. M. Gilligan*. (Jour. Agric. Res., XXXIII, 8 (Oct. 15, 1926), pp. 741-752.) [63.295.]

Some New Facts concerning Onion Mildew, *P. A. Murphy*. (Jour. Dept. Lands and Agric. (Dublin), XXVI (1926-27), 2, pp. 115-126 +6 pl.) [63.24.]

Live Stock

Modern Swine Husbandry, *Lord Bledisloe*. (Jour. Farmers' Club, Dec., 1926, pp. 88-109.) [63.64.]

Dairying

The Effect of Pasteurisation on the Nutritive Value of Milk, *J. B. Orr, A. Crichton, J. A. Crichton, E. Haldane, W. Middleton*. (Scottish Jour. Agric., IX, 4 (Oct., 1926), pp. 377-385.) [63.717.]

The Proportion of Water in Milk, *J. F. Tocher*. (Scottish Jour. Agric., IX, 4 (Oct., 1926), pp. 351-356.) [614.32; 63.712.]

Poultry

Poultry on the Farm, *Stanley Street-Porter*. (Jour. Farmers' Club, Nov., 1926, pt. 5, pp. 1-86.) [63.651.]

The Nutritive Requirements of Poultry. VII. Note on Growth in Chickens (Preliminary Communication), *J. B. Orr, G. Scott Robertson, A. Kinross, G. Lewis*, and *H. Newbiggin*. (Scottish Jour. Agric. IX, 4 (Oct. 1926), pp. 392-395.) [63.651.043.]

Economics

The Relation between Cultivated Area and the Population: Presidential Address to Section M of the British Association Meeting, 1926, *Sir Daniel Hall*. (Advancement of Science, 1926.) [338.9.]

Some Causes of Effects of Changes in Prices of Farm Produce, *A. W. Ashby*. (Jour. Roy. Agric. Soc. England, vol. LXXXVI (1925), pp. 99-112.) [338.5.]

International Comparison of Price Changes, *A. L. Bowley*. (London and Cambridge Economic Service Special Memo, No. 19, July, 1926.) [338.5,]

Wheat Acreage and Production in the United States, 1866-1925. (Wheat Studies of the Food Research Institute, Stanford University, California, vol. II, No. 7 (June, 1926), pp. 236-264.) [63.311 : 31 (73).]

The Productivity of British and Danish Farming, *R. J. Thompson*. (Jour. Roy. Stat. Soc., vol. LXXXIX, Part 2 (March, 1926), pp. 217-255.) [31 (42) (489); 338.1 (42) (489).]

An Enquiry into British Methods of Crop Estimating, *J. A. Venn*. (Econ. Jour., vol XXXVI, No. 143, (Sept., 1926), pp. 394-416.) [31 (42); 311.]

Small Holdings, *A. G. Ruston*. (Trans. H. and Agric. Soc. Scotland, vol. XXXVIII (1926), pp. 28-54.) [333.38.]

Hail Insurance: Its Economic Aspects, *A. Manes* and *W. Rohrbeck*. (Int. Rev. Agric. Econ. IV, 3, July-Sept., 1926, pp. 331-380.) [368.5.]

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NOTES FOR THE MONTH

Marketing of Home Produce

As already stated in this JOURNAL,* a grant of £40,000 a year for five years has been made to the Ministry by the Empire Marketing Board for the purpose of carrying out further investigations into the marketing of home-grown agricultural produce and for demonstrating improved methods. The following is a brief report of progress since August 5, 1926, when the grant was authorized.

Publications.—Two Reports in the Economic Series were issued in the autumn, namely, No. 11 (*Marketing of Poultry*) and No. 12 (*Marketing of Pigs*). With the help of the grant, an arrangement was made whereby these two Reports were issued at 6d. net, and all further sales of No. 10 (*Marketing of Eggs*) are being made at that figure. Of the Economic Series as a whole, nearly 20,000 copies had been sold to December 31, 1926. The largest sales of individual Reports at that date were as follows :—

No. 8—*Agricultural Credit*	1,300	(Published February, 1926)
No. 1—*Co-operative Marketing*	1,800	(„ April, 1925)
No. 12—*Marketing of Pigs*..	1,800	(„ October, 1926)
No. 11—*Marketing of Poultry*	4,200	(„ October, 1926)
No. 10—*Marketing of Eggs*	4,300	(„ January, 1926)

Having regard to the normal sales of official publications, these results are considered to be satisfactory. It may be added that one producers' organization—the Scientific Poultry Breeders' Association—has purchased 2,000 copies of Report No. 11 (*Marketing of Poultry*) for free distribution among its members. This is an example which other organizations might usefully follow in order to aid in disseminating the information and suggestions which these Reports contain.

A comprehensive Report on the *Marketing of Fruit* (Economic Series, No. 15) will be published shortly, and will also be issued at the nominal price of 6d. a copy. Investigations

* Vol. XXXIII, November, 1926, p. 689.

into the marketing of milk, cereals, and pig products are approaching conclusion; investigations are in progress in regard to public and private markets in England and Wales, and also in regard to the marketing of cattle.

Marketing Demonstrations.—An essential feature of the Ministry's scheme is the demonstration of improved methods of marketing, *i.e.*, packing, grading, etc. A preliminary experiment in this direction was made at the Show at Birmingham on November 2-4 last, which was held under the auspices of the Birmingham Agricultural Exhibition Society and the Midland Federation of Feather and Fur Societies, when a large egg and poultry marketing exhibit was shown. This proved to be successful and attracted much attention. Arrangements are being made to repeat it at a number of agricultural shows in 1927, and also to have similar demonstrations in regard to the marketing of pigs and pig products, fruit and potatoes. A detailed programme will be given in the next issue of the JOURNAL.

In connexion with the egg and poultry marketing demonstration at Birmingham four leaflets, dealing with packing, grading, etc., were specially prepared and issued. These leaflets have been and still are in keen demand; over 10,000 copies of each have been distributed on application. Similar leaflets will be prepared in due course on other marketing subjects.

Grants-in-Aid.—A grant of £1,500, spread over a period of two years, has been authorized to the Cheshire Cheese Federation, with the object of assisting the Federation to bring into operation its proposals for raising and standardizing the quality of Cheshire cheese. The proposals involve the use of a trade mark, and constitute an experiment in marketing reform which will be watched with interest, not only by cheese producers, but by farmers generally.

A grant at the rate of £1,000 per annum for two years has been offered to the National Farmers' Union to enable the union to take steps towards organizing the marketing of live stock in areas affected by foot-and-mouth disease.

In order to encourage the export of agricultural seeds to the Dominions, the expense of carrying out tests at the National Seed-Testing Station, at Cambridge, is being defrayed from the grant. The total outlay involved is estimated at £300.

British Industries Fair and Ideal Homes Exhibition.—The Empire Marketing Board acquired space at the British Industries Fair, which is being held at the White City from February 21 to March 4, 1927, and asked the Ministry to

organize a section devoted to home-grown food products. Various representative organizations were accordingly invited to collaborate with the Ministry for this purpose. The National Farmers' Union, working through organizations such as the Western Curers' Association, British Sugar Beet Society, National Association of Cider Makers, British Glasshouse Produce Marketing Association, National Federation of Fruit and Potato Trades' Associations, Cheshire Cheese Federation, and, where necessary, through individual firms, undertook to arrange a display of home-produced bacon, beet sugar, cider, glasshouse produce, seed potatoes, dairy produce, and eggs, and was allotted a substantial part of the space available. In addition, separate space was provided for the Food Manufacturers' Federation, and for the National Food Canning Council. No pains were spared to make the exhibit not only representative of the marketing side of the agricultural industry, but worthy of the home country.

Somewhat similar arrangements have also been made in connexion with the Ideal Homes Exhibition, which will be held at Olympia from March 1 to March 26, except that, in this case, the exhibits will be of a more popular character. The National Milk Publicity Council, National Association of Cider Makers, British Glasshouse Produce Marketing Association, Food Manufacturers' Federation, and the National Food Canning Council have agreed to stage displays. With a view to stimulating the consumption of potatoes, arrangements have also been made by the Ministry for a demonstration of the culinary possibilities of potatoes to be given at the exhibition every evening.

* * * * * *

Clean Milk Competitions in 1924-25

A REPORT, under the title here given, was recently issued by the Ministry, and deals with clean milk competitions held by County Agricultural Education Committees in England and Wales.* It is hoped that this Report will be of interest, not only to those who have organized, or contemplate organizing such competitions, and to farmers, but to the public generally, since any movement for education in clean milk production must, ultimately, benefit the consumer.

A comparative statement is included, showing that in the year 1924-25, 24 competitions were held, covering 26 counties,

* Miscellaneous Publications, No. 56. Price 4d., post free, direct from the Ministry.

with a total of 563 competitors, owning, between them, 15,467 cows. These figures, compared with the respective figures—seven counties, 181 competitors and 4,662 cows—for the year 1923-24, disclose a very rapid increase in the popularity of these competitions. An interesting feature of the Report is a map showing the counties which have already held, or have definitely arranged to hold, competitions, and from this it will be seen that the movement now covers practically the whole country.

Whereas the County Agricultural Education Committees have assumed the chief responsibility for promoting and organizing these competitions, they have been assisted in many cases by public health authorities, local milk recording societies, local show societies, local branches of the National Farmers' Union, and by the distributing trade. Support from these sources, and from the National Milk Publicity Council, has also taken the form of the provision of prizes, medals, etc., for successful competitors.

The Report states that the County schemes followed, in the main, the principles recommended in the Ministry's *Guide to the Conduct of Clean Milk Competitions*,* and that these recommendations were found to work well in practice. Problems, such as preliminary organization, cost, prize schemes, and sections into which competitions should be divided, are discussed at some length; and the advantages of holding competitions, extending over both winter and summer months, are also discussed. The procedure for, and experience gained from, farm inspection, and from the examination of milk for bacteria, sediment and keeping qualities, are outlined; and a note is given upon the type of competitor concerned. Features which, as clearly shown by the reports of the inspecting judges, are vital in the production of clean milk, are duly set out; of these, adequate supervision and the co-operation of employers and employees are not the least important.

The Report shows that competitions have been successful in securing an all-round improvement in the quality of the milk supply of those competing. Many competitors have remarked on the greater interest shown by milkers in their work, and have been encouraged to take out a licence to produce Certified or Grade A milk. As a future development it is suggested, *inter alia*, (1) that employees should be

* Miscellaneous Publications, No. 43. Price 4d. post free, direct from the Ministry.

encouraged by the giving of a small bonus, depending on the quality of milk produced, and they should be induced to compete in county milking contests; and (2) that the distributive trade and the public generally should recognize that the highest quality milk is worth a higher price. Thus the prospect of obtaining an adequate return would encourage the producer to incur the additional expenditure in equipment and labour which is required to produce milk of the highest quality.

Primary Producers' Organization and Marketing Act, Queensland

THIS Act, which was assented to on November 20 last, repealed the Primary Products Pool Acts, 1922-25, and the Primary Producers' Organization Acts, 1922-25, then operating in Queensland. It provides for the constitution of a Council of Agriculture composed of members elected from commodity boards which are to be set up for any primary product to which the Act applies or shall be applied. The expenses of the Council are to be met by the establishment of "The Queensland Producers' Fund," into which will be paid the contributions of the commodity boards. This fund is to be augmented during the first year of operation by a grant not exceeding £15,000. The commodity boards are subject to the approval by regulation of the Governor in Council, vested with wide powers. They are entitled to make a levy in respect of the commodity for which they are constituted, in order to meet administrative expenses, payments to the Council of Agriculture and the establishment and maintenance of insurance funds covering damage by pests, fire, hail, flood, etc Local producers' associations may be registered to take the initiative in local matters and to support and assist the commodity boards and the Council.

Subject to a two-thirds majority of producers, a pool may be established for any commodity; the commodity board is then constituted a marketing board. Existing pool boards will continue to function. Payment will be made on the basis of the net proceeds of the sale of all the commodity of the same quality or standard, delivered to, and sold by the board, and the proportion of such commodity delivered by the grower. Advances may be made by the marketing board on account.

A Director of Marketing is to be appointed to act as liaison officer between the boards, the Council of Agriculture and

the Government; he will serve as an ex-officio member of each marketing board.

Provision is made for the maintenance of the existing organization in the cane sugar industry. This consists of a mill suppliers' committee for each sugar mill, district cane growers' executives to deal with the business of each sugar district, and a cane growers' council elected by all those engaged in sugar production. The Act also leaves it open to any primary industry to adopt a similar organization.

The intention underlying the Act is that the producers shall develop their own powers of organization and distribution; each primary industry will only prosper to a degree directly proportionate to the loyalty of its members and the manner in which the organization has been built up.

* * * * * *

The Disposal of Surplus Milk

THE question of utilizing milk, not sold for consumption in liquid form, was a matter of considerable concern during the war period, not only from the point of view of the producer, but also because of the necessity for conserving the food supplies of the country. The surplus on an individual farm was not very large in itself, perhaps, and, although the value to the producer was appreciable, it would not usually have been a paying proposition to convert it into cheese. In the aggregate, however, the quantity of surplus milk on farms within a radius of, say, five miles of a small country town was often sufficient to justify the setting-up of a central cheese-making factory on a co-operative basis.

In order to bring to the notice of farmers the advantages of disposing of their surplus milk by co-operative cheese production, the Ministry, with the assistance of county authorities for agricultural education, introduced in 1916 a scheme for the establishment of co-operative cheese-schools. The scheme, in outline, provides that, before a school is undertaken at any centre, the milk producers in the district applying for a school have to form a representative committee, which must undertake (*a*) to provide premises in which the school can be held, (*b*) to deliver at a selected centre a stated minimum quantity (usually not less than 200 gallons) of milk per day, (*c*) to agree to accept payment for the milk supplied on a strictly co-operative basis, that is from the results obtained from the sale of cheese produced, and (*d*) to take an active part in the business of the undertaking. These requirements being satisfied, the education authority then conduct a school for a period of two or three

months, or until an adequate demonstration has been provided. The necessary plant is loaned to the authority by the Ministry without charge, and other expenditure, *e.g.*, the salary of the dairy instructress, who usually runs the demonstration school, is recouped to the extent of two-thirds under the Ministry's Educational Grant Regulations. The normal result of holding such a school has been the formation of a co-operative cheese-making factory. In many cases the apparatus loaned by the Ministry has been taken over and paid for by the society, so that the factory has started operations in full working order.

From the commencement of the scheme in 1916, until 1921, over 60 schools were held in 17 counties, the greater proportion being in Wales ; and in more than 40 cases the farmers either formed a society of their own or joined a society already in existence. In some other cases where no society was formed the farmers continued to make cheese on a co-operative basis.

Since 1922, however, there has been a marked decline in the demand for co-operative cheese-schools and, apart from those held in East Sussex, of which a note is given later, only seven schools have been held. In two cases societies were formed, and in three other cases the farmers joined a society already in existence. In one of the two remaining cases no result accrued, and in the other the farmers have continued to make cheese at the depot without forming a society. This decline of interest in the co-operative movement, besides reducing the number of schools held, has had an adverse effect on the success of many of the societies which had been formed, with the result that only 10 were functioning during 1925, and of these one or two were not receiving an adequate supply of milk. In two or three other instances the depots were still in existence, but were being maintained only as an alternative outlet for milk in the event of a disagreement with the distributing trade.

The main reason for this decline is probably the increase in collective bargaining for the disposal of milk to the distributing trade which has taken place during the last few years, and the provision made in the resulting contracts for the purchase of surplus milk at manufacturing prices.

In the case of East Sussex, success has attended the efforts to introduce a system of co-operation. A co-operative cheese-school was held at Hurstpierpoint in 1922, followed by another at Lewes in 1923, and two others, at Robertsbridge and East Grinstead, in 1924. Each of these centres, with two or three others in addition, has now been established by the East

Sussex Dairy Farmers' Association as a milk depot, and is equipped with cheese-making plant, so that the surplus remaining after the contracts for liquid milk have been fulfilled may be converted into cheese on the spot. The farmers in the Association are therefore assured that the whole of the milk they produce will be disposed of in the most advantageous manner.

Following on the success of this scheme, a co-operative system is being adopted in Essex; other areas, including Wiltshire and Hampshire, have somewhat similar proposals under consideration.

In those areas where the homestead conditions are such as permit of either resuscitation or adoption of cheese making as a home industry, and where accessibility to good markets and other considerations justify a conclusion that cheese making would be a paying proposition, another scheme of instruction is in operation, which is an adaptation of the scheme first introduced soon after the passing of the Technical Instruction Act (1890). This scheme is also administered by county agricultural education authorities, and consists of short courses of instruction which are given at selected centres. The average duration of such a course is 10 to 14 days, and the apparatus employed is as simple as can be used to deal efficiently with the quantity of milk which would be available on the class of farm from which the pupils are drawn. Under this scheme the amount of instruction given has been well maintained since its inception. In 1925 instruction was provided in 21 counties, the total number of schools held being 83, and 710 persons in all were instructed.

There is, however, ample scope for the extension of this class of instruction, though not, perhaps, so much as in the case of co-operative cheese-schools. Despite the alleviation of the surplus milk problem in some parts of the country, it is still evident that the question is a very pressing one, and the co-operative cheese factory offers, it would appear, the most satisfactory solution. Still, while the Ministry and county education authorities are anxious that the advantages of such co-operation should be brought to the notice of farmers, it is with the farmers themselves that the success or failure of the system lies, and the main purpose of the co-operative cheese-schools is that they may have a practical demonstration, under their own supervision, of the possibilities of the scheme. The apparatus which the Ministry has available for loan at the present time would be sufficient to equip about 16 co-operative

cheese-schools, eight travelling cheese-schools, and eight travelling schools for instruction to small-holders.

Grassland Conference at Cambridge

THE success of the Conference for Agricultural Organizers and Advisers, held at Oxford University in the Spring of 1925, has led the Ministry to arrange for a similar series of meetings at Cambridge University during the coming spring. It is proposed that the subject for discussion at the forthcoming Conference will be "Grassland," considered under such headings as (a) the nature of good pasture, (b) improvement of poor pastures, (c) mineral deficiencies of pastures, (d) temporary leys versus permanent pasture, etc. The Conference, at which both the Minister and the Parliamentary Secretary hope to be present, will commence on the evening of April 7 and end on the morning of April 13. The Ministry has circulated a letter to County Authorities for Agricultural Education, giving notice of the Conference and requesting the Authorities to allow their respective Agricultural Organizers to attend.

Country of Origin of Seeds

REFERENCE was made, under this title, in the August, 1926, issue of this JOURNAL* to the regulations, which had come into operation in the United States of America in the previous May, requiring that all red clover and alfalfa seed or any mixture containing 10 per cent. or more of these seeds imported into the States shall be stained with distinctive colours according to the countries or regions from which they come. Amended regulations have now been issued which require that red clover from Italy and alfalfa from Turkestan and South Africa shall be stained red to the extent of at least 10 per cent. of the seed in each container—which signifies that the seed is not adaptable for agricultural conditions in the United States. Seeds coming from countries whose products have been found adaptable shall be stained green or, in the case of seed grown in Canada, iridescent violet. The staining in this case must be to the extent of at least 1 per cent. of the seed in each container. The staining is carried out under customs supervision, and in the presence and under the direction of a customs representative. No

* Page 454.

seed can be coloured under customs supervision until notice of the colour to be applied has been received from the Bureau of Plant Industry of the United States Department of Agriculture.

It is understood that that department has under consideration the desirability of requiring alfalfa seed from any part of South America to be given the warning 10 per cent. red colour which would stamp this seed as being not adaptable for general agricultural use in the United States.

The Milk and Dairies Order, 1926

THIS Order may, in certain cases, necessitate structural alterations and additions to existing cow-sheds and dairies as well as more adequate provision for water supply and drainage on many dairy farms. The Lands Improvement Company is prepared to make advances to landowners for these and other improvements. The company is incorporated under special Acts of Parliament, 1849 to 1920, administered by the Ministry of Agriculture and Fisheries. The procedure is simple, as there is no investigation of title or deposit of deeds required. The outlay is charged on the property benefited and repaid by way of annuity, spread over a maximum period of forty years, according to the durability of the improvement.

Full particulars can be obtained from the Secretary, The Lands Improvement Company, 58 Victoria Street, S.W. 1; the facilities available for landowners are also described in the Ministry's Leaflet No. 59, a copy of which may be obtained free of charge on application to the Ministry.

CHARACTERS WHICH DETERMINE THE ECONOMIC VALUE OF GRASSES

I. NUTRITIVE VALUE AND PALATABILITY

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IT is proposed in this and subsequent articles to consider briefly those characteristics of grasses which chiefly influence their economic value. The economic value of a grass depends in the last resort not only upon its palatability and nutritive value, but equally upon its ability to maintain itself and withstand the conditions of management superimposed upon it. It will be necessary, therefore, first to consider nutritive value and palatability and, later, to deal with such properties of grasses as affect these characteristics, and which influence persistency and aggressiveness.

Nutritive Value.—Although it is now generally admitted that chemical analyses of a feeding stuff do not afford a complete index to its nutritive value, it is yet true that recent investigations in this field have thrown an important light on the question as applied to grasses. Particularly is this so with reference to the different parts of a grass and in relation to the degree of maturity of these different parts. It is, therefore, necessary shortly to review the chemical evidence, for it affords an important key to a correct appreciation of the differences, in habit and in growth, between one grass and another, which largely determine their economic value.

For the purpose of present discussion, it is sufficient to confine attention to crude protein, true protein, fibre and ash.

In Table I, results obtained with 10 species of grasses by Fagan and Jones* during two seasons, 1922 and 1923, have been averaged; when more than one strain of a particular species has been used, the two strains have been averaged.

It will be seen that there is a striking difference, in all cases, between the composition of the hay and the pasture, and that the aftermath approaches much more closely to the pasture than to the hay. Hay, of course, represents full-grown and adult herbage, while a series of pasture cuts represents young and immature growth, and aftermath is intermediate between the two. The pasture and aftermath

* Fagan, T. W., and Jones, Trefor H.: *The Nutritive Value of Grasses as Shown by Their Chemical Composition*. Welsh Plant Breeding Station, Bulletin Series H, No. 3, June, 1924.

cuts are predominantly leafy, and the hay cut predominantly stemmy. Comparing the species one with another, it will be noted that there is far less difference in chemical properties between the pasture produce than between the hay produce, and that there is usually an altogether greater difference between hay and pasture of one and the same species than between the pasture of any two different species.

There can be no doubt, moreover, that analyses of hay can never be relied upon to give a correct comparison between different species—for, with the best will in the world, it is impossible to harvest a number of different species of grasses in precisely the same stage (physiologically considered) of growth. Taking the figures as a whole then, and having regard to the wide difference between hay and pasture, and the relatively slight differences between species and species when estimated on the pooled produce of a number of pasture cuts (which of course levels up all differences as to growth stages), we see the profound influence of stage of maturity on nutritive value, and the no less profound difference between leaf and stem.

TABLE I.—To compare the Chemical Composition (crude protein, true protein, fibre and ash) of Pasture Grass with Hay and with Aftermath in the case of 10 species of Grasses.

The figures are the average of two seasons, 1922 and 1923, Cocksfoot, Perennial Rye-grass, Timothy and Tall Oat-grass being represented by indigenous and commercial strains. The figures for these have been averaged. *After Fagan and Jones—see text.*

	Crude protein			True protein			Fibre			Ash		
	Pasture*	Hay	Aftermath	Pasture*	Hay	Aftermath	Pasture*	Hay	Aftermath	Pasture*	Hay	Aftermath
Cocksfoot	14·6	7·3	12·3	10·2	5·7	10 1	28·8	35·4	31·1	9·7	5·4	9·5
Perennial Rye-grass ..	12·8	6·6	10·3	9·9	5·1	8·4	24·9	30·8	25·9	10·1	5·0	8·7
Timothy	11·8	6·5	10·2	8·8	5·2	7·7	24·9	28·9	26·1	8·7	4·1	9·3
Tall Oat-grass ..	15·5	7·6	12·3	10·1	6·0	9·4	25·8	29·5	28·2	9·6	5·1	9·1
Golden Oat-grass† ..	14·6	8·9	10·7	11·0	6·6	7·9	25·8	32·3	28·2	10·7	4·7	10·8
Crested Dogstail† ..	12·6	5·6	12·7	9·3	4·6	9·6	26·0	31·2	27·0	8·1	4·5	9·6
Red Fescue†	13·9	7·5	10·8	10·4	5·9	8·2	27·0	34·9	27·6	9·7	4·5	10·4
Meadow Fescue† ..	13·8	7·2	10·4	10·3	5·5	7·1	26·4	34·5	28·6	10·4	5·8	10·2
Tall Fescue†	12·2	5·5	9·8	9·0	4·5	6·7	27·5	33·3	27·9	9·3	4·6	9·2
Meadow Foxtail† ..	14.2	11·8	10·4	10·5	9·7	7·4	26·9	28·7	30·6	9·6	6·8	8·5
Greatest range between different species‡ ..	3·7	6·3	2·9	2·2	5·2	3·4	3·9	6·7	5·2	2·6	2·7	2·3
Greatest difference between the hay and pasture of one and the same species ..	7·9			4·8			8·1			6·0		

* Pasture: Average of six cuts in 1922; average of eight cuts in 1923.
† Indigenous only.
‡ Strains considered as species in the pasture cuts for purpose of this comparison.

TABLE II.—To compare the Chemical Composition (crude protein, true protein, fibre and ash) for the Leaf and Stem respectively of Pasture Grass for Cocksfoot, Perennial Rye-grass, and Timothy. *After Fagan and Jones—see text.*

	Crude protein			True protein			Fibre			Ash		
	Stem	Leaf	Difference	Stem	Leaf	Difference	Stem	Leaf	Difference	Stem	Leaf	Difference
Cocksfoot—Indigenous .. 1922 ..	17·5	28·3	10·8	13·1	24·8	11·7	30·4	19·7	10·7	9·4	11·5	2·1
1923 ..	13·1	18·1	5·0	9·0	14·8	5·8	36·3	26·5	9·8	12·9	13·9	1·0
Danish, and U.S.A... 1922 ..	16·3	28·5	12·2	12·1	24·9	12·8	31·3	19·4	11·9	10·2	10·8	·6
1923 ..	13·9	19·2	5·3	10·1	15·4	5·3	31·8	25·4	6·4	14·0	14·4	·4
Perennial Rye-grass, .. 1923 ..	12·9	21·6	8·7	9·8	16·7	6·9	27·5	22·1	5·4	7·8	11·2	3·4
Timothy—Indigenous .. 1923 ..	12·5	21·9	9·4	9·9	16·2	6·3	31·4	24·4	7·0	7·7	10·7	3·0
Greatest range between the four different strains and species .. 1923 ..	1·4	3·8	—	1·1	1·9	—	8·8	4·4	—	6·3	3·7	—

1922—Average of 9 cuts. 1923—Average of 5 cuts.

TABLE III.—To show some features of the Chemical Composition of Stem Shoots and Leaf Shoots respectively in the Hay for five species of Grasses.* *After Osvald.*

	Crude protein		True protein		Fibre		Ash	
	Stem shoots	Leaf shoots	Stem shoots	Leaf shoots	Stem shoots	Leaf shoots	Stem shoots	Leaf shoots
Timothy ..	8·29	10·38	6·94	8·85	26·1	21·7	3·86	5·09
Cocksfoot ..	8·76	12·32	6·79	10·41	26·2	22·3	4·85	5·79
Meadow Foxtail	8·57	13·50	7·66	11·78	26·5	22·8	4·64	5·48
Meadow Fescue	8·38	13·38	6·88	10·88	24·9	21·3	5·62	6·30
Smooth - stalked Meadow - grass	8·25	11·19	7·44	9·69	25·9	23 5	4·19	4·73

* Figures taken for Table III from "Torestorp," from Osvald, Hugo, "Undersökningar öfver fodervärdet hos olika gräs från slåttervallar pa torfjord," in *Svenska Mosskulturföreningens Tidskrift*, Ar. 1919, p. 156.

This difference between leaf and stem is further emphasized by reference to Tables II and III. In Table II further data presented by Fagan and Jones† have been summarized. The analyses have been made on the stem and leaf separately from pooled pasture cuts—the "stem" for the most part has been the sheaths of the leaves, and the "leaves" have been the actual blades. In Table III analyses made by Osvald‡ on the herbage from a rich pasture in Sweden are given. Here the difference is not between stem and leaf as such, but between stem shoots (consisting of stems with their leaves) and leaf shoots (which consist of root leaves with their sheaths, but without stem). Thus the leaf shoots are wholly leaf (in the morphological sense of the word) and the stem shoots predominantly stem. Osvald's analyses were made on plots in the hay condition. The results given in both tables are in marked agreement and show the altogether higher protein and ash content of the leaves, while the stems contain considerably the most fibre. Comparing the leaf of the pasture cuts (Table II) with the leaf shoots of the hay (Table III), it will be seen how much richer the pasture leaves are than the hay leaves, again showing the fall in nutritive value as leaves reach maturity. The striking difference between the sheaths and blades of the pasture leaves, as demonstrated by the figures in Table II, is important. The figures in these

† Fagan and Jones, *loc. cit.*

‡ Osvald, Hugo, *see* footnote to Table III.

two tables are in confirmation of those in Table I, for again the tendency is for the difference between leaf and stem of one and the same species to be greater than that between the leaves of different species. Recent investigations, reported jointly from the Rowett and Cambridge Nutrition Research Institutions,* are fully in accord with the above statements, for herbage taken from closely grazed areas has differed appreciably from that taken from neglected patches on the same fields. The "eaten" patches are, of course, leafy and relatively immature, while the "non-eaten" will be more mature and more stemmy. Thus the nitrogen content is higher in the "eaten" than the "non-eaten," while the fibre is at its highest in the "non-eaten."

Perhaps the most informing results have been those obtained by Christoph,† who conducted critical analyses chiefly on Cocksfoot, and also with Perennial Rye-grass and Tall Oat-grass. He made analyses of all the parts of the plant separately, and did so at several different stages of growth. The results for protein, ash and fibre in the case of Cocksfoot at the beginning and end of flowering have been abstracted from Christoph's paper and are shown in Table IV.

In the first place, the figures show for all the leaves and the stem a fall in protein and ash content and a rise in fibre with increasing maturity. It should be noted also that the upper (younger) stem leaf is richer in protein than the lower (older) stem leaves. The difference between stem and leaf (taking the leaves as a whole) is on a par with the results previously discussed. The chief interest of the figures is, however, the strikingly high protein content of the root leaves and the inflorescences (the spikelets and flowers, not including the branches of the panicle). The root leaves always maintain a long period of growth and new leaves are constantly developed; thus the effects of maturity are to a considerable extent counter-balanced, so that these leaves always retain a relatively high protein and ash content. The inflorescences, unlike the leaves and stems, increase in protein and ash content as flowering and ripening progress.

* "The Mineral Content of Pastures": Investigations carried out under the direction of W. E. Elliot, J. B. Orr, and T. B. Wood. *The Scottish Journal of Agriculture*, Vol. VIII, No. 4, October, 1925, p. 349.

† Christoph, Karl: "Untersuchungen an *Dactylis glomerata* L., *Lolium perenne* L., und *Avena elatior* L." *Zeitschrift für Pflanzenzuchtung*, Bd. X, 1924-25, p. 311.

TABLE IV.—To show the Chemical Composition of Different Parts of Cocksfoot at the beginning and at the end of the flowering stage. *After Karl Christoph*—(See foot note to text).

Parts of the plant	Crude protein		Pure protein		Fibre		Ash	
	Beginning of flowering	End of flowering	Beginning of flowering	End of flowering	Beginning of flowering	End of flowering	Beginning of flowering	End of flowering
Root leaves ..	18·32	13·16	15·38	12·54	30·52	31·59	12·48	11·91
Lowest stem leaf	8·22	6·14	6·64	5·26	32·29	34·81	12·15	11·66
Second „ „	9·78	7·32	7·94	6·76	35·30	36·77	11·65	11·61
Third „ „	11·52	8·80	9·60	8·70	35·79	36·68	11·36	11·33
Uppermost stem leaf	14·54	13·26	11·58	10·52	36·65	37·65	11·20	10·74
Inflorescences ..	16·68	19·96	13·62	16·32	37·64	31·68	7·63	9·23
Stem proper ..	5·78	4·20	3·94	3·34	45·13	45·37	5·55	6·30

The facts here brought together indicate that, in order to understand the economic properties of different grasses, it is necessary to give prominence to the study of the ætiology of leaf and stem development. From the grazing point of view, it is grasses that will continue to produce an abundance of root leaves that count, because when leaves keep growing they maintain their nutritive value better than stem leaves, and they are not dependent on stem production for their existence. Although inflorescences, as such, are of high nutritive value, they are not desired on pastures, even when taken by stock, because they are not produced again and again, and they are accompanied by stem and by stem leaves. In the hay, inflorescences are of great value, for, as well as being highly nutritious, they with their stems contribute most to the yield. Root leaves are, of course, also of value in the hay, though excess of root leaves may add to the difficulties of hay-making. The high nutritive value of inflorescences shows how important it is to cut the hay before waste follows from the shedding of seed, and shows further the necessity of studying grasses from the point of view of (1) rapidity of seed setting and ripening, (2) their ability to withstand shedding, and (3) the proportion which inflorescences proper bear to the rest of the panicle and to the fibrous panicle-bearing stem.

The rapidity with which grasses grow is also a matter of great importance, for those which grow rapidly if left alone will become relatively poor in nutriment more quickly than the slower growing species.

We see, then, that the nutritive value of a grass at any particular time depends more on its growth stage, and its stem to leaf ratio, than on the inherent chemical properties of its various parts; thus real differences that may exist between species and species, and strain and strain, are exceedingly difficult, and perhaps quite impossible, to estimate with any absolute degree of accuracy. The average figures given in Table I go far to show that when the produce fairly represents all growth stages, with varying, but more or less equal, degrees of maturity, the difference in chemical properties between the different species, although in some few cases probably real and pronounced, is, speaking generally, not as material as is perhaps usually supposed.

It is well to realize that the nutritive value of the different parts of a grass is largely determined by the functions they have to perform. Christoph, for instance, points out that in young leaves the cells will not have attained to full growth—the vacuoles will be small and, consequently, these leaves will contain relatively much protoplasm; moreover, the mechanical supporting tissue of such leaves is also relatively insignificant—a fact which shows itself in the low fibre content. Root leaves, it is explained, as well as individually maintaining growth for some time, are always being supplemented by new leaves, so that, even when left ungrazed, old tissue will be mingled with new, and in consequence a fair nutritive value maintained. The leaves are the assimilating organs and thus contain a higher proportion of protein materials than stem; transpiration carries water with minerals in solution to the leaves, where it evaporates, leaving foliage also with a higher ash content than stem.

The stem is but a carrying and supporting organ and is therefore rich in hard strengthening tissue (*sclerenchyma*), showing itself in a high fibre content. The relation of strengthening to other tissue varies considerably, not only according to the age of the stem or leaves, but also as between species and species: this has been well shown by Bews.* Broadly speaking, species with excess of strengthening tissue, or organs in a state of maturity, are less nutritious and less

* Bews, J. W.: *The Grasses and Grasslands of South Africa.* Pietermaritzburg, 1918.

palatable than species with relatively little strengthening tissue or with organs in a state of immaturity.

Palatability.—Probably of greater importance than the inherent nutritive value of herbage is its palatability. This question of palatability has been discussed in some detail by Davies* in this JOURNAL, and more recently by Gibb and others elsewhere.† The most important point to observe is that grasses in general are most palatable, just as they are most nutritive, when they are young and in a state of active growth and of immaturity, and thus, generally speaking, it is the root leaves that excel in palatability, while leaves as a whole are more palatable than stem. Thus the dominating influence affecting the palatability or the reverse of a pasture, at any particular time, is the growth stage in which the majority of the plants are discovered, and this is, of course, in turn affected by methods of stocking, manuring, climate, soil and all the other factors influencing the growth of the plants. Individual species differ in inherent palatability, but in the case of grasses these differences are probably most generally due not so much to subtle variations in taste or nutritive value as to considerable differences in mechanical texture.

Very hairy plants are not usually palatable, and it is this defect which, probably more than any other, renders Yorkshire Fog, for example, relatively unpalatable to stock, especially when at all mature.

Leaves that are excessively harsh, although eatable, are not readily palatable—a good example of a grass with leaves of this sort is Tall Fescue. Leaves with strongly serrated or barbed margins, though again often eatable enough, are not palatable and will be neglected as long as more favourable herbage is available. Cocksfoot is a grass with a tendency to have somewhat barbed margins—the strains differ very much in this respect. Recent trials at Aberystwyth have shown that sheep evinced a decided preference for plots consisting of strains with the barbs reduced to a minimum. Harshness, sharpness of barbs and the like are influenced by growth stage; they are pronounced in proportion as the leaves reach

* Davies, Wm.: "The Relative Palatability of Pasture Plants," this JOURNAL, Vol. XXXII, May, 1925, p. 106.

† Gibb, J.: "Palatability of Grasses," *Research Annual*, 1926, McGill and Smith, Ltd., Ayr, and "Palatability of Grassland," *ibid.* See also M'Dougal, Capt. A. R.: "Pasture Improvement on High Land," *The Scottish Journal of Agriculture*, Vol. VIII, 1925, p. 136.

maturity—an important matter this in relation to the management of a grass like Cocksfoot.*

Palatability falls rapidly as grasses become winter burned. Nutritive value falls no less rapidly, and it is in their reaction to winter burn that grasses probably differ more widely from each other, in relation to nutritive value and palatability, than in any other single respect. It should be added that, although species differ thus considerably in relation to winter burn, in all species alike stem leaves burn more freely than root leaves, mature leafage more freely than immature leafage.†

Thanks are due to Miss Rhoda Jones, B.A., and to Mr. A. R. Beddows, B.Sc., for preparing some of the data on which this paper has been based.

* * * * * *

A PLOUGHING MATCH

The following article, "From a Correspondent," appeared in The Times *Educational Supplement for December* 4, 1926, *and is reprinted here by permission of the proprietors of that paper, and of the author, to whose courtesy the Ministry is indebted. The article will be of particular interest to all those concerned with agricultural education and the creation of an agricultural bias in the training of children in rural districts.*

THERE were five schoolmasters on the field to watch the ploughing match, though four of these are on the retired list. But there were no schoolboys present; no teacher had brought up his class for the sake of the educational advantage of the occasion. Down in the city five miles away many classes were taking "organized games" in the parks, and were supposed to be spending their time well; yet the rural school, close by the field to be ploughed, ignored the match and kept its scholars penned up.

We take town children to big halls and give them fine concerts to develop their power of appreciating good music; but we do not take country boys to a field four furlongs from their school, even when past masters in the art of ploughing, who for ten years have acted as judges at such contests, are

* Christoph (*loc. cit.*) states that Holy (see *Berichted. Landw. Inst., Halle*, 1907 18) has proved that leaf margins of Cocksfoot, supplied with barbed teeth, have an injurious effect on the mucous membranes and glands of the digestive organs of domesticated animals.

† Stapledon, R. G., and Davies, Wm.: "Winter Burn (or 'Browning,') of Herbage Plants," this JOURNAL, Vol. XXXII, February, 1926, p. 1002.

demonstrating to their juniors just how such work should be done. The Director of Education in this very district is fond of talking about the immense moral value of getting boys and girls to wish and to try to do something superlatively well—writing, sewing, singing. Well, here was a six-acre field ploughed perfectly; it was unanimously agreed that one might go a hundred miles and not see another like it; and here was a company of a hundred modern yeomen keenly watching and discussing the work, as the chilled-steel mould-boards, smooth as ice, turned over the furrow slices. The be-ribboned horses entered into the spirit of the occasion. A quiet, serious spirit pervaded the field; and in the November sunshine master farmers showed their sons and servants just how ploughing should and could be done. Many a boy, had he been watching for half an hour, would have found a hero, and would have resolved that he, too, would learn to plough like that, and would be proud to share in so fine a pursuit as agriculture.

These men were allowed 5½ hours to plough half an acre. So the field was set out in half-acre plots, a splendid opportunity being thus given for one to learn to know what an acre really is, a thing one cannot learn in school. Indeed, one could readily have found four or five "sums" involving square measure for boys to have worked as they waited, finding out that arithmetic was of some use. And what a useful pleasant time could have been spent over the plough itself, for of course there was a spare one, an old Roberts, on the field. All country boys, and indeed town boys too, ought to have a lesson on the plough. We give them lessons in mechanics, with little toy pulleys and wedges and inclined planes and so on; but how much more practical and businesslike to have an actual plough, borrowed from a farmer, and to study its parts and their functions. Here are levers, wedges, and wheels. And surely the mould-board, or breast—which deftly turns the slice that coulter and share have cut—the one vertically and the other horizontally—is a beautiful example of the inclined plane.

How deep does one plough? And how is the depth increased or decreased? How wide is the furrow-slice, and how is that width altered? What is the function of the furrow-wheel and of the land-wheel? And how did the ploughman manage with the old swing-plough that has no wheels at all? These things can be found out by examination, but are better taught by demonstration on the field. The wheel standards and coulter clip have their interest, though they do not raise questions

about forces, as do the hake-and-chain or the bridle, swing-trees and chains, and the pull of the horses. How long are the handles or stilts ? Anyone can see that, as they are levers, there would be greater mechanical advantage were they ten feet long instead of six ; yet on the field any boy would see, and say, that with longer handles headlands would have to be wider and reins longer, whilst control over the horses would be less. Surely the thinking out of all the points about these stilts is as good mental exercise and as good " mechanics " as many other things we do in school.

It would puzzle many a clever person who looks on a newly ploughed field to say just what path has been followed by the plough. From ridge to ridge measures one chain ; but how are the ridges set out when several ploughs are to work together ; and how are these furrows formed ? In these days of binders, furrows have to be shallow ; but why ? And looking over a finished land one sees a perfectly clean surface, no grass or stubble or manure lying upon it, if a prize ploughman has worked. How is that done ? At our ploughing match one could see the ball and chain hanging on the plough, the former gently forcing the grass below the surface as the machine moved on. But however well this is done the grass will grow in the seams of the ploughing if the winter be mild.

Here is the place to talk about the skim-coulter. This is really a miniature plough in itself. It is on the beam, and travels in advance of the plough's cutting parts ; it pares away the edge of the furrow-slice, turns it over, and puts it at the bottom of the furrow so that it is covered up by the slice of clean earth turned on top of it. The skim is a very necessary contrivance when there is manure to be ploughed in.

The fact is that the modern plough is quite as well worth study as is an engine or a voltameter or an Attwood's machine or a calorimeter. It has a long, long history behind it. One can easily obtain pictures showing the primitive plough still in use in the East—say, in Palestine—to-day. Then one may get the catalogues of the great British makers and see the most modern ploughs—disc ploughs ; digging ploughs that leave the soil as well broken and the rubbish as well buried as if the work had been done with a spade ; ploughs that take out four furrow-slices at once ; the double mould-board plough for preparing the land for turnips and for earthing potatoes. The modern idea is to plough so that the furrow-slice falls over and breaks and leaves a surface without any distinct lines and in a state fit for a seed bed. But we need not with our schoolboys

go into all the details. We are told that boys should read just enough good literature in school to give them a taste for it, so that they eagerly seek it when schooldays are over. In the same way we may open their eyes to what is happening in the world of agriculture, make them eager to know the history of the plough, its development during the last hundred years, the possibilities still before it, and the interest and joy of the ploughman's life. What one will never be able to explain is why a ploughman should be regarded as an unskilled labourer and paid less than a tram conductor or street-sweeper. We may, however, make them see what industry, science, ingenuity, experience, observation have gone and are going into the development of this oldest and most indispensable of the world's arts. And we may make them see how honourable an occupation it is, what demand it makes on one's brain, and how satisfying it is as one's calling in life.

Of course the plough and ploughing form only one item in farm work. Almost every other has its educational side too, which even the elementary school should not ignore. At our ploughing match we could see in the next field men at work drilling in wheat and immediately harrowing after it. How much seed do they use to the acre? And how much ground will a man sow in a day? And what has been done to the ground to prepare it for the sowing? All the year round there are things of this sort to be studied, and schools in or on the edge of the country might well base all their work in science and nature study on these things of the farm.

It is a good sign that ex-schoolmasters should be so keenly interested in a ploughing match. One of our four was secretary. Another is now finding a very profitable occupation in advising farmers about their grass land, and what mixtures of seeds to use for a one, two, three, or four years' ley. For 25 years he has studied this matter closely; now he represents a large firm of seed growers, and sells for them. Did he when at school bring this special knowledge of his into his "schemes of work"? Did his boys and girls grow up to think of agriculture as an occupation for folk with brains, and as being a line of life vastly more attractive than any the city could offer? Did he educate his pupils by bringing them into contact with the living, growing things of the farm, and with the poetry of them? In short, did he ever take his boys to a ploughing match and fill their minds with information such as that of which we have spoken? Perhaps he did. Certainly younger men, coming to the country with more open minds on the

subject of the scope and method of education, must do all this. It must not always be a case of "the ploughman homeward plods his weary way"—for his way is not necessarily more weary than that of other people. We must put the other side—

No courtier may
Compare with them who clothe in grey
And follow the useful plough.

If ever the countryside is to come to its own again the country school will have a hand in the doing of it; and if ever education, urban as well as rural, is to become more natural, more sincere, more truly popular, more genuinely effective on the fortunes and souls of the nation, the reformation will probably start with a demand from country people.

PIG CARCASSES FOR WILTSHIRE BACON

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School of Agriculture, Cambridge,
and
J. ANDREASEN,
Manager, St. Edmundsbury Co-operative Bacon Factory, Ltd.

IT might be imagined that sufficient information is available to guide the pig keeper in the selection of pigs that meet the requirements of the curer of Wiltshire bacon, but the writers believe that something more detailed than has yet been published, assisted by photographic views, not only of sides, but also of cuts, might help the breeder of bacon pigs to understand more clearly the importance of the points which are stressed by the factories. The teacher and student of animal husbandry, too, will find little in textbooks on pig keeping about this subject, beyond a brief summary of the somewhat idealized "standards of excellence" as laid down by the various pedigree breed societies.

The Grocer's Requirements.—The demands of the consumer must be the standard by which the producer is controlled, and so, in buying sides of bacon, the grocer or other retailer is guided in his selection by the requirements of his customers. While certain portions of a side of bacon are boiled, the greater part is required for the breakfast table. This usually means frying in thin slices, and the cuts of bacon in greatest demand are those which, when fried, will not break up or lose their shape too much, and which at the same time have the proportions of lean and fat which suit the public taste.

From this aspect, that is, solely from the consumer's point of view, it is interesting to make a preliminary investigation of the cured bacon side. As the slices or rashers have to be of a convenient size for frying, the side has first of all to be divided into a number of " cuts " of a manageable size. Not being of uniform dimensions throughout, and containing, even when cured, a few bones, the cuts cannot be made symmetrically; and so in the majority of cases the Wiltshire side is cut up in the manner illustrated in Fig. 1, although there are, of course, minor local variations. From this it will be seen that a preliminary division is made into fore-end, middle, and gammon. With the exception of " picnic " hams, formed from the shoulder, the term " ham " is used for the hind leg when it is cut off the carcass before curing, and in such cases it is cut into a more oval shape than the gammon, which is removed by a straight cut (1).*

The final division produces ten different cuts, and Figs. 2 to 11 illustrate how these appear when cut from a good quality side. It will be seen at once that there is a very great difference between the shapes and the proportions of individual cuts, and this gives the key to the different value set on each by the grocer. The following description will help to indicate the reason for these different values.

Gammon Hock.—The view of this cut given in Fig. 2 suggests that it is very full of lean meat and as suitable for boiling as

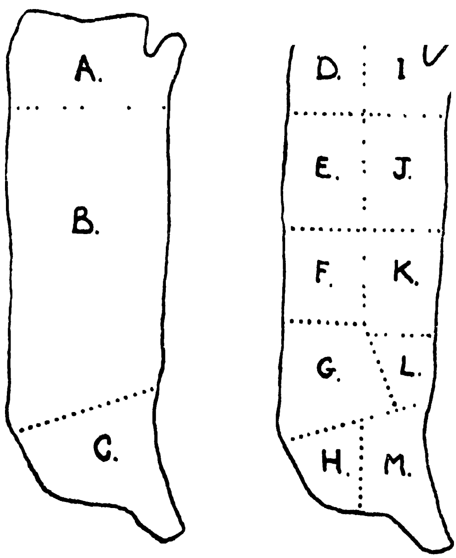

FIG 1.—Division of a bacon side into grocer's cuts.

* For references see p. 1102.

Fig. 2

Fig. 4

Fig. 3

[*Photos* H. R. Davidson

Fig. 2.—Gammon Hock. Sizeable 8·7 lb.=15·6 per cent.
Fig. 3.—Corner Gammon. Sizeable 4·4 lb.=7·9 per cent.
Fig. 4.—Long Loin. Sizeable 3·2 lb.=5·7 per cent.

To face page 1096.

FIG. 5. Short Back. Sizeable 4·3 lb., 7·7 per cent

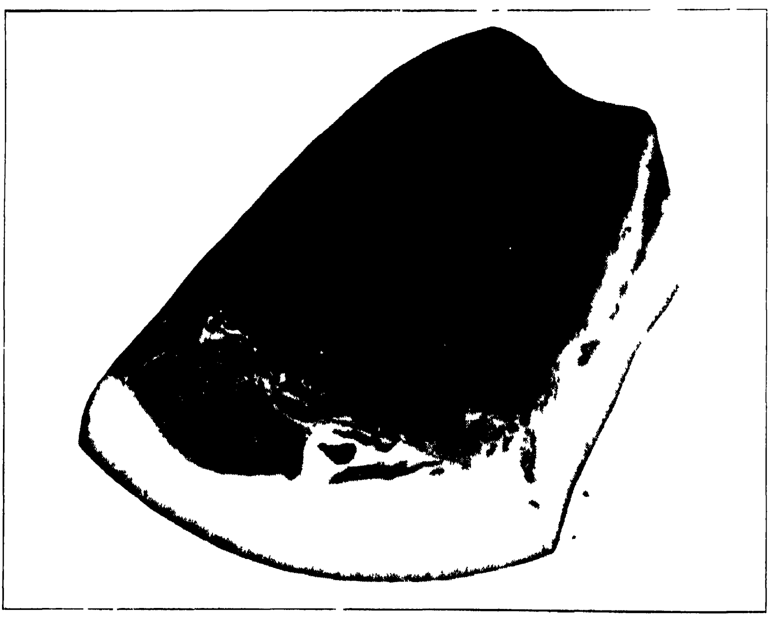

FIG. 6. Rib Back. Sizeable 8·8 lb., 15·8 per cent.

Fig. 7

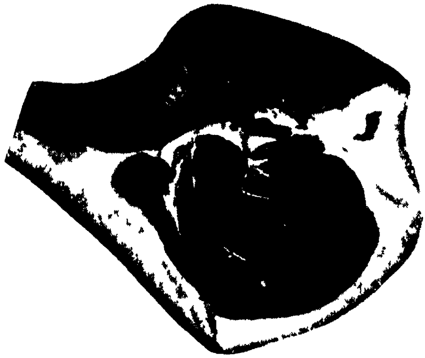

Fig. 8

Fig. 9

Fig. 7 Flank Sizeable 2.6 lb 4.6 per cent
Fig. 8 Thin Streaky Sizeable 2.8 lb 5.0 per cent
Fig. 9 Thick Streaky Sizeable 5.2 lb 9.3 per cent

Fig 10

Fig 11

Fig 12

Fig 10 Collar Sizeable 7 3 lb — 13 0 per cent
Fig 11 Forehock Sizeable 8 6 lb 15 4 per cent
Fig 12 Fat "Short Back" from stout side. Sizeable 4 8 lb = 9 1 per cent

Fig. 14—Thin Streak. Compare with Figs. 6 and 9

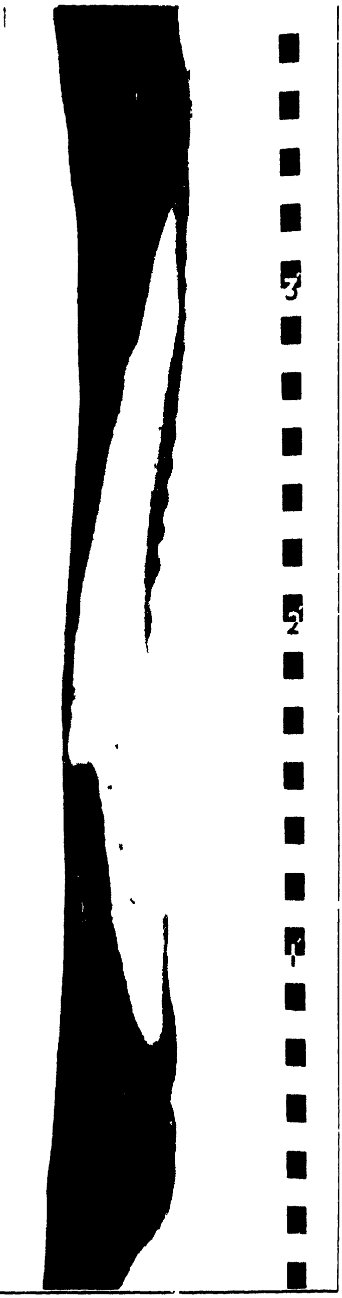

Fig. 13—Seedy Cut, widely distributed throughout the belly.

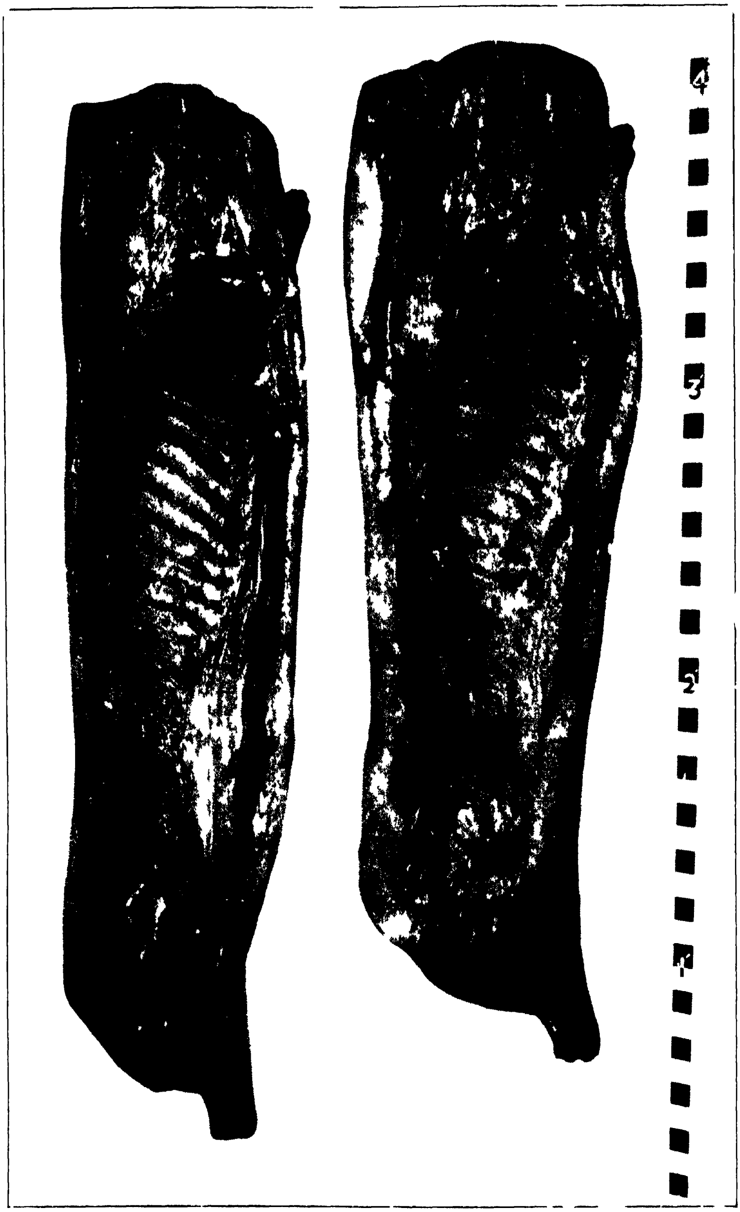

FIG. 1[illegible]—He[illegible] [illegible] Comp[illegible] with depth [illegible] end [illegible] the longer and b[illegible]tter side

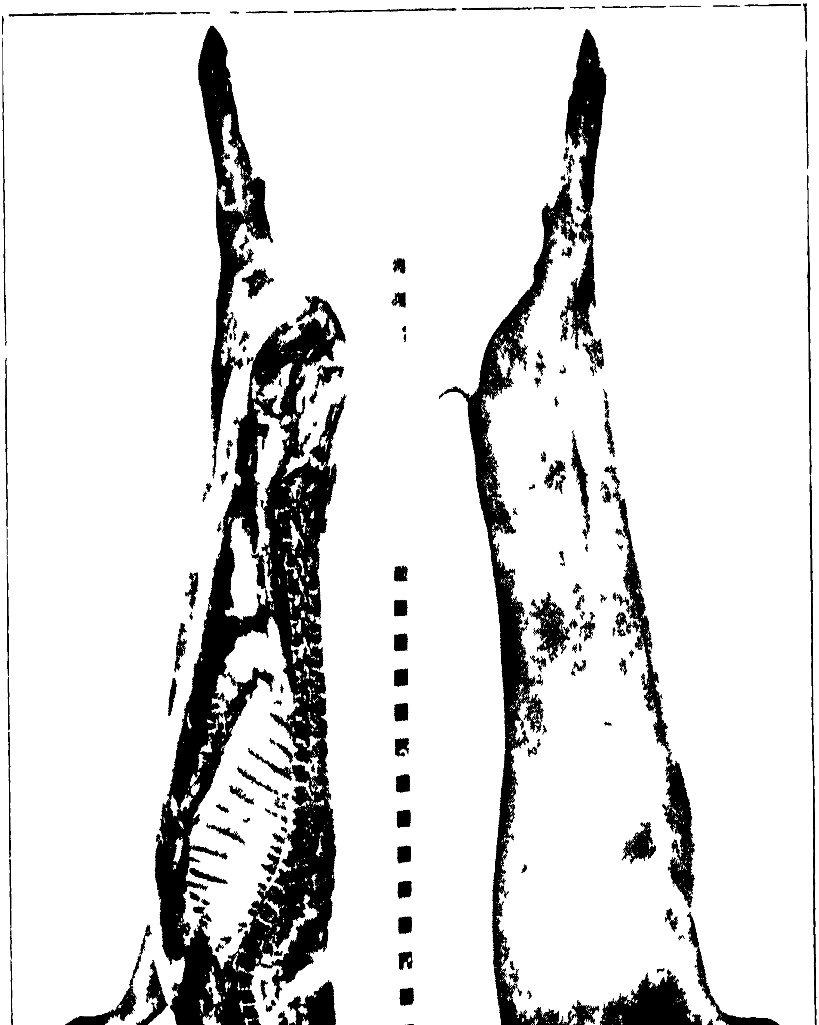

Fig. 16. Ideal bacon carcass. Compare with specification on page 1101.

the corner gammon, but it has to be remembered that the photograph does not show the shank part of the leg at the back, which consists almost entirely of bone. For this reason the value per pound is very considerably less than several other cuts.

Corner Gammon (Fig. 3).—This represents the meat near the root of the tail and, when properly cut, contains nothing more than a small piece of the leg bone. It is essentially suited for boiling as, unless cut from a very fat pig, it consists almost entirely of lean flesh. It is equivalent to the choicest part of a boiling ham.

Long Loin (Fig. 4).—While of a size and shape suitable for producing very good rashers, with a nice proportion of lean to fat, this cut as a whole contains a higher proportion of bone (mostly " oyster bone ") than the other back cuts.

Short Back (Fig. 5).—This cut shares with the corner gammon the distinction of being higher priced than any other. It is easy to see that an attractive rasher can be cut from it, and there is hardly any bone present to reduce the total amount of meat.

Rib Back (Fig. 6).—Here again the suitability for slicing into rashers is obvious ; and it is probably only the amount of rib bone present which relegates it to sharing second place with the long loin.

Flank (Fig. 7).—Coming next to the underpart of the pig, it may at first sight seem surprising that the flank should be recognized as almost the poorest cut. The large expanse of lean meat, however, does not extend very far into this piece, and the bulk of it when sliced gives such a narrow rasher that it dries up almost to a string when fried.

Thin Streaky (Fig. 8).—Both of the streaky cuts are well known to the housewife and are justifiably popular on account of the alternate layers of lean and fat. The thin streaky, however, coming as it does next to the flank, is liable to suffer from the same trouble of thinness. For this reason it is not quite so popular as the thick streaky, and it is easy to understand the very great importance placed by curers on thickness of streak or belly when grading carcasses at the factory.

Thick Streaky (Fig. 9).—Provided that the belly is thick, this can always be relied on to give satisfactory rashers selling at a price only slightly lower than those from the back.

Collar (Fig. 10).—With the exception of the flank, both of the cuts comprising the fore-end are the lowest priced of all

the cuts, and from the photographs it is not difficult to understand the reason. During the process of curing, the blade bone or shoulder blade is removed from the part of the side which becomes the collar, and this leaves an irregularly shaped space, part of which is seen in the photograph, and which obviously interferes with the possibility of cutting an unbroken slice. In addition, it will be seen that the muscles run in all directions, some of them going to the neck to support the massive head and others to the foreleg. Connected with this, too, is much gristle, which forms the attachments of the muscles to the bones.

Fore Hock (Fig. 11).—A similar criticism can be applied to the fore hock which in addition suffers, like the gammon hock, from the presence of a considerable portion of leg with its attendant waste.

The actual weights and values of the side which is illustrated are summarized in Table I, which indicates what the public wants and therefore what the retailer demands from the factory.

TABLE I.—PROPORTIONS AND VALUES OF CUTS IN A GOOD QUALITY WILTSHIRE SIDE.

Cut	Weight lb.	Per cent. of total weight	Price per lb. s. d.	Value of cut s. d.	Per cent. of total value
Gammon hock ..	8·7	15·6	1 5¼	12 5½	—
Corner gammon ..	4·4	7·9	2 5¾	10 11	-
Long loin	3·2	5·7	2 1	6 8	-
Short back ..	4·3	7·7	2 5¾	10 8	
Rib back	8·8	15·8	2 1	18 4	--
Flank	2·6	4·6	1 0½	2 8	—
Thin streaky ..	2·8	5·0	1 7¾	4 7	--
Thick streaky ..	5·2	9·3	1 10	9 4½	--
Collar	7·3	13·0	1 2¾	9 0	-
Fore hock ..	8·6	15·4	0 9¾	6 11½	—
Gammon	13·1	23·5	1 9½	23 4½	25·5
Middle	26·9	48·1	2 0	52 3½	57·1
Fore end	15·9	28·4	1 0	15 11½	17·4

The summary at the bottom of the table shows quickly which parts of the carcass are the most desirable, but the more detailed figures given above explain the reasons for these variations.

The Curer's Requirements.—It might be thought that any pig carcass which would produce a cured side, suitable for the retail trade, would be satisfactory from the curer's point of

view ; but there are in practice several other factors of great importance in connexion with factory management. While the farmer is familiar with the fact that the primary offals are removed from the pig before he is paid on the weight of the carcass, it must also be remembered that there is a further considerable shrinkage in weight due to the removal of the secondary offals during the process of curing. These secondary offals consist of the following parts :—

Head.	Tender loin (equivalent to "undercut" of beef).
Feet.	Aitch bone (pelvic bone).
Tail.	Blade bone (shoulder blade).
Backbone.	Kidneys.
Leaf fat (lining the abdominal cavity).	

In the case of a 200-lb. live pig the loss from live to dead weight is approximately 25 per cent., while the loss of secondary offals from carcass to cured side is about 20 per cent. of the carcass weight, or 15 per cent. of the live weight (2). These are, however, only average figures, and there is very considerable variation between individual pigs. It is obvious, therefore, that the carcass which is most profitable to the factory is one in which the secondary offals form the smallest possible proportion. It is true that they are not wasted, but taking them as a whole, they do not realize more than half of the price per lb. which is obtained for the bacon, although the farmer has to be paid at the factory for the whole carcass, including these offals.

The question of carcass weight, too, is of considerable importance to the factory, and for this reason. A pig which yields a carcass weighing less than seven score (140 lb.) is seldom, if ever, sufficiently mature to give a high enough proportion of lean and fat to bone, and there is also a very grave risk that the streaky will not be sufficiently thick. On the other hand, when the carcass weighs more than nine score (180 lb.) two serious faults generally appear. The back fat is nearly always too thick, and there is a tendency for the fore end to assume too great a proportion in relation to the middle.

Faulty Sides.—Having discussed the valuable points, it is important to examine the faults which have to be avoided in maintaining a regular supply of best quality bacon.

Fat Sides.—It is easy to see why the factories specify that the back fat should be even and not more than $1\frac{1}{2}$ in. to 2 in. thick. Fig. 12 is a photograph of a "short back" from a stout pig, and indicates the unpleasant nature of a rasher from such a cut.

Seedy Cut.—Seedy cut, an example of which is shown in Fig. 13, is a black or reddish brown discoloration which occurs in the bellies of many black or red pigs. It represents the milk-producing tissue of the udder, and as the ducts or tubes of the udder tissue are formed from the skin during the growth of the embryo pig, it follows that this tissue will be of the same colour as the skin of the udder. For this reason, seedy cut is never noticed in white-skinned pigs and is mostly troublesome in the black breeds. Gilt pigs, which have not been spayed, develop more udder tissue than spayed pigs, and so are more apt to show seedy cut; but it may even sometimes occur to a slight degree in hog pigs just under the nipples. It is not in any way harmful, but is very much disliked, and so the factories usually remove that part of the belly in which it occurs, and as a result lose several pounds of otherwise valuable bacon. While seedy cut does not occur in all black pigs, the preference for white-skinned pigs can be easily understood.

Thin Streaks.—In view of the great depreciation in value as the streaky cuts get too thin to be fried successfully, the importance of a thick belly is easily understood. In nearly all cases this tendency to thinness is due to faulty breeding, as indicated in Fig. 14. In this it will be seen that, in spite of the thin flank, the back fat is thicker than it ought to be, indicating that there was no possibility of the pig having been starved.

Soft Fat.—Bad texture of the lean, and particularly of the fat, is responsible for a greater depreciation in value than possibly any other fault, and it is unfortunately very difficult to detect before slaughter. Very much still remains to be learnt about this difficulty, but with the exception of pigs which have been ill or very unthrifty, soft fat must be mostly attributed to bad feeding. There is reason to believe, however, that pigs which fatten very rapidly because of good management will produce firmer fat than animals fed on the same rations, but which have suffered from general unthriftiness.

Heavy Fore Ends.—The loss due to this fault can be gathered from Table I, but Fig. 15 illustrates an unbalanced side of this kind.

The Farmer's Ideal Bacon Carcass.—It has already been pointed out by one of the writers (3) that the production of an ideal carcass is really only one-third of the problem of bacon production, and that both high fecundity and rapid growth affect his financial results to an equal or even greater degree. Confining our attention at present, however, to the

carcass, the points which the farmer should try to achieve are the following (*see* Fig. 16) :—

(i) A carcass weight of from 140 lb. to 170 lb.
(ii) Small proportion of secondary offals, particularly head, feet, and coarse bones.
(iii) Light fore end.
(iv) Full, well-shaped gammon, well fleshed down to hock.
(v) Long middle, 36½ in.
(vi) Back fat even ; preferably 1½ in. but not over 2 in.
(vii) Thick streak and flank, not less than 1¼ in.
(viii) Absence of seedy cut.
(ix) Firm fat.

In the past, the St. Edmundsbury Co-operative Bacon Factory, Ltd., at Elmswell, Suffolk, has been able to give a bonus of 1/- per score on all pigs which come within the proper weight limits, and which are neither too thick in the back fat nor too thin in the streak, provided always that the faults which have been specially mentioned are also absent. For the present, while the home bacon-curing trade is passing through such a difficult time, the management committee of this factory is not able, unfortunately, to pay this bonus. It is hoped, however, that the passing of the depression will allow the payment to be resumed, as it represents about 8/- per pig, or, approximately, 6 per cent. of the cost of production. Apart from the immediate increase in selling price, the improvement of the carcass is of importance, because it is only by producing a standardized article, which meets the market requirements, that the breeder will be able to create for British bacon the constant and regular demand so essential for the welfare of the industry.

Breeding Investigations.—With the object of finding out how to produce the largest number of first-grade pigs, an investigation was recently carried out at the experimental farm of the Elmswell factory. A number of pure and cross-bred pigs were bred and fattened, and full details of each carcass were obtained from the factory after slaughter. In Scandinavia [(4) and (5)] it is possible to obtain information of this kind for a very large number of herds, but so far the results obtained at Elmswell are almost the only ones obtainable in this country. Owing to an outbreak of swine fever the experiments had to be stopped last year, but even the first results obtained are suggestive. Although the total number of pigs was not great enough to make the percentages sufficiently reliable for detailed

publication, it was found that where the pure-bred pigs were used the grading tended to be uniform, whereas first-cross pigs, although they are generally believed to be very thrifty, tended to vary very much as regards quality of carcass, between the different qualities of their parents.

This indicates that what might have been suspected from theoretical considerations does actually occur in practice, and that the selection of valuable pure-bred strains of tested carcass quality may be a more profitable line of procedure than the present almost universal practice of producing first-cross animals. At any rate, the results so far obtained show how important it is that further tests should be made on a large scale in order to obtain information of this kind for the majority of herds in the country.

Conclusion.—An effort has been made to demonstrate in some detail the class of pig carcass which the farmer should attempt to produce if he wishes to supply a factory dealing with Wiltshire bacon. The best way to understand the reason for these details is to begin with the bacon as sold over the counter and, working back from that, to see first of all what is the kind of side which appeals to the grocer, and then to examine the class of carcass which the curer requires in order to produce such a side. The present somewhat vague recommendations before the farming public to breed "long" and "deep" pigs are not sufficient, and attention must now be directed towards studying closely the actual dimensions of high quality sides, and then the factors concerned in their production. A beginning has already been made in Scotland by the institution of a pig testing station under the control of the Animal Breeding Research Department of Edinburgh University, but a wider development of these investigations, including the institution of pig recording societies, which would greatly increase the scope of the testing station, is required if information is to be obtained regarding the requirements of different branches of the bacon and pork trade.

REFERENCES.

(1) Nicholls, *Bacon and Hams* : Inst. of Certificated Grocers, 4 Cullum Street, Fenchurch Street, London, E.C. 3 (1924).

(2) Departmental Committee on Distribution and Prices of Agricultural Produce. *Interim Report on Meat, Poultry and Eggs*, H.M. Stationery Office, 1924.

(3) Davidson, H. R., *Jour. Large Black Pig Soc.*, No. 23, Vol. 6, July, 1926.

(4) Davidson, H. R., *Jour. Min. Agric.*, Vol. XXXII, Nos. 10, 11, 12 (Jan., Feb., and Mar., 1926).

(5) Davidson, H. R., *Scot. Jour. Agric.*, Vol. IX, Nos. 2 and 3, April and July, 1926.

THE AGRICULTURAL ECONOMICS RESEARCH INSTITUTE, UNIVERSITY OF OXFORD

C. S. ORWIN, M.A.,

Director of the Institute.

THIS Institute was established in 1913 as the result of the University's application to the Ministry of Agriculture for a grant in aid of economic research in agriculture. A grant of £600 per annum was given, the University contributed a further £300, and the Master and Fellows of Balliol, to show their interest in the work, voted £50, so that the total annual income available at the start was £950.

The responsibility for the Institute within the University devolved upon the Committee for Rural Economy, and this Committee delegated its functions to an Advisory Committee for Agricultural Economics, composed mainly of resident members of the University, together with one or two other people who were thought likely to be helpful by reason of particular qualifications.

No scheme of work had been planned for the new Institute. The study of the structure of the agricultural industry and of the organization of the farm is a comparatively recent development of modern agricultural research. In its earlier stages the investigation of the farmer's problems was limited to matters arising out of the application of the physical and biological sciences to the production of crops and to the breeding and feeding of live stock; and the setting up of the Institute in 1913 marks the realization of the fact that the study of economics can serve the farming community in many important ways. One of the hardest facts that experience has taught about agriculture is that "good" farming, *i.e.*, the generous application of capital and labour to the business of production from the land, is not necessarily synonymous with "successful" farming. What the farmer needs, therefore, is the means to reduce to a minimum the economic uncertainty inherent in his business, and this can only be provided by a systematic study of the industry in all its aspects.

Not only is such study necessary in the interests of the farmer and his men, but information is needed also for the better understanding of the larger question of the place of agriculture in national economy, and of the problem of the direction in which development is desirable.

There are many who are ready to prescribe for the ailments of the industry, their proposals including such things as the reform of land tenure, the closer settlement of the land, industrial farming, the adoption of Danish methods, and so forth. All these require interpretation in the light of prevailing conditions, and, whilst it is obviously outside the sphere of the investigator to apply himself to that which is often mere political propaganda, it is no less certain that it is his clear duty to study the facts of the situation and to elucidate them in a manner such as may assist the community to form right judgments upon questions of agricultural policy.

Accommodation of the Institute.—In its early days, accommodation for the small staff was obtained in Barnett House, the centre of social economic studies in Oxford. Later, rooms were allocated in the new buildings of the School of Rural Economy, which were in course of erection at the time of the outbreak of the war. As the work developed, however, in the years following the cessation of hostilities the available space proved inadequate; moreover, the growing requirements of the School made it desirable that it should resume occupation of the rooms loaned. Accordingly, in 1924, a grant was made by the Development Commissioners in aid of new buildings. This grant was applied by the University to enlarging Museum Cottage, a small house in Parks Road, situated most conveniently next door to the Schools of Rural Economy and Forestry. The new home of the Institute, reconstructed under the supervision of Mr. P. Morley Horder, F.S.A., was first occupied in August, 1925, and it has been described as "a model of elegant simplicity." The only feature of particular note is its library, as the other requirements of the staff are well met by the provision of rooms sufficient to allow of work being carried on without the congestion which marked the closing days of the life of the Institute in its old quarters. The rooms and passages are ornamented by a small loan collection of agricultural prints, which includes some fine examples of the art of William Ward (1766-1826), most of them engraved from paintings by Thos. Weaver.

Early Work of the Institute.—Coming to the work of the Institute, the first approach to the study of farm management problems was made by means of costing. Costing is, of course, only the means; it is not the end itself. Moreover, it is only one means by which to examine farm organization. A good deal of pioneer work was needed to secure the interest and

General Exterior View

The Library

THE AGRICULTURAL ECONOMICS RESEARCH INSTITUTE, UNIVERSITY OF OXFORD

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The Brothers Colling of Ketton Co Durham from an old engraving in the collection of agricultural prints at the Institute

The Ketton Ox known also as the Durham Ox bred by the Brothers Colling From an old engraving in the collection of agricultural prints at the Institute

THE AGRICULTURAL ECONOMICS RESEARCH INSTITUTE

co-operation of farmers, and there was also much to be done towards the definition of principles and the evolution of methods which called for experimental work in agricultural costing as a preliminary to research. Work on these lines occupied the time of the Director and his staff of two assistants during the first year.*

Although the costing method was thus the first line of attack on the problems of agricultural economics, it was always realized that it would not be sufficient in itself, and it was suggested by Prof. W. G. S. Adams, a member of the Advisory Committee, that valuable information could be collected by means of economic surveys. The evidence to be got in this way would be less complete than that furnished by the more intensive costing method ; on the other hand, a much greater mass of it could be collected by the expenditure of an equal amount of time and energy. At the outset these surveys were planned to deal with particular problems, and Mr. A. W. Ashby made a study of allotments and small holdings,† whilst Mr. J. Orr surveyed the systems of farm management prevalent in the counties of Oxfordshire and Berkshire.‡ This method, however, was found to be incomplete, for, although it must happen that special problems will arise for investigation, the study of farm economics as a whole cannot best be pursued by the examination of particular questions. Thus it was decided to inaugurate general surveys, designed to collect information of every kind which could be got by inquiry on the farm, to tabulate this in a variety of ways, and then to study the tables in order to see what information they afforded. The method has been made familiar by the work of American farm economists. Then came the interruption of the war, and although the work never stopped entirely, it was continued under conditions of difficulty and in a much restricted form.

In 1919 the Institute may be said to have experienced a new birth. Additional financial provision was forthcoming, and the experience gained in the earlier years opened up a clearer view, both of the problems to be attacked and of the methods of approach. Work was developed upon the lines

* C. S. Orwin, *Farm Accounts* (second edition), 1924. Cambridge University Press. *Farming Costs* (second edition), 1921. Oxford University Press.

† A. W. Ashby, *Allotments and Small Holdings in Oxfordshire*, 1917. Oxford University Press.

‡ J. Orr, *Agriculture in Oxfordshire*, 1916. Oxford University Press. *Agriculture in Berkshire*, 1918. Oxford University Press.

both of the costing and the survey methods, and other inquiries subsidiary to this were also undertaken.

Work in Progress.—The work now in progress may be summarized under the following heads: (*a*) Farm Management Studies; (*b*) Rural Life Studies; (*c*) Miscellaneous Studies; (*d*) Work in the Advisory Province of Oxfordshire and Northamptonshire; (*e*) Education.

Farm Management Studies.—These are carried on by personal investigation amongst farmers, whose co-operation in the work is essential. The methods of study may be distinguished as follows:—

(1) Costing.
(2) Analysis of financial accounts.
(3) Surveys: (*a*) directed towards the investigation of the whole business of the farm; (*b*) dealing only with individual products or particular problems.

About 75 farms are being studied by the first and second methods, including 28 farms representing some 12,000 acres which are fully costed. The surveys made embrace about 900 farms in category (*a*) in the following districts:—

District	Type of farm	No. of farms
(1) Thames Valley district of Oxfordshire ..	Mixed	90
(2) Oxfordshire (North)	Arable	172
(3) Northamptonshire	Feeding and Dairying	
(4) Oxfordshire (South)	Mixed	145
(5) Oxfordshire (South)	Mixed	119
(6) Wiltshire	Dairying	200
(7) Northamptonshire	Dairying	70 (approx.
(8) Northamptonshire and Leicestershire ..	Feeding	80 (approx.

As to surveys in category (*b*), perhaps the more important relate to the sugar beet problem* and to the question of the marketing of farm products.† Both investigations are being continued. An important study of the Law of Diminishing Returns is now nearly completed, and other studies are in hand.

Rural Life Studies.—These, so far, have been limited to a survey of the Rural Industries of England and Wales.‡ The

* A. Bridges and R. N. Dixey, *Sugar Beet: Research Monograph* No. 3, Ministry of Agriculture and Fisheries, price 1s., post free.

† F. J. Prewett, *The Marketing of Farm Products, Part I, Live Stock*, 1926. *Part II, Milk* (in the press). Oxford University Press.

‡ Vol. I, *Timber and Underwood Industries, and Some Village Workshops*, 1926; Vol. II, *Osier Growing, Basketry Industries, and Some Rural Factories*, 1926; Vol. III, *Decorative Crafts and Rural Potteries* (in the press); Vol. IV, *The Rural Industries of Wales* (in the press).

function and place of local industries in rural life cannot be overlooked in any consideration of the development of the countryside, and this survey was undertaken to throw some light upon the question of the survival of village crafts in a highly industrial country.

Miscellaneous Studies.—Perhaps the most noteworthy work in this division completed so far is the *Agricultural Atlas of England and Wales.** Other investigations now in progress include an inquiry into the incidence and extent of unemployment in agriculture and the problem of live-stock insurance.

Work in the Advisory Province of Oxfordshire and Northamptonshire.—The Institute undertakes advisory work in farm economics in this province. The main activities are concerned with costing and financial accounts, and advisory and organization work in connexion with the marketing of farm produce is being developed. In co-operation with the Agricultural Organizers of the two counties, lectures, both single and in the form of short courses, are arranged from time to time.

Education.—Work of a more directly educational character is undertaken by the Institute through the supervision and instruction of post-graduate students holding scholarships from the Colonial Office, the Ministry of Agriculture and Fisheries, and the Board of Agriculture for Scotland. The scholarships differ in character, and in the length of tenure ; some of the scholars become members of the University and engage in definite research work, whilst others remain for a shorter period and receive a course of training in the methods of approach to the study of the economic problems of agriculture. Public lectures to farmers' clubs, village clubs, and similar organizations are delivered by various members of the Institute staff from time to time.

Space does not allow of anything more than this outline of the work of the Institute, but a full report has been issued and anyone interested can obtain it by application to the Secretary.†

* J. Pryse Howell, *An Agricultural Atlas of England and Wales*, 1925. Ordnance Survey Department, price 10s.

† *The Work of the Agricultural Economics Research Institute, Oxford* (second issue, 1926), 1s., post free.

THE DOWNY MILDEW OF THE HOP IN 1926

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THE year 1926 is likely to be memorable in the history of hop growing in this country, as witnessing, for the first time, attacks of the downy mildew on the ripe or nearly ripe cones in a number of hop gardens, spoiling the colour wherever it occurred, and in many instances causing hops to be picked before they were ripe. In some cases a few acres of hops were left unpicked as worthless for the market. In view of certain alarmist statements, however, made by those imperfectly acquainted with the facts, it may be well to point out here that the proportion of hops affected with the downy mildew in the English crop of 1926 was infinitesimal. A detailed account of all the outbreaks known is given below.

In previous numbers of this JOURNAL,* accounts have been given of the life-history of the Downy Mildew (*Pseudoperonospora humuli*) and of the disease it causes on the growing hop plant and the cones. The present article deals with the further outbreaks that have taken place on the Continent and in this country, with certain facts observed in the life-history of the fungus, and the control measures most likely to keep this new disease in check.

Distribution on the Continent.—*Germany.*—The hop gardens in Bavaria and Wurtemberg are beginning to be seriously affected, as those at Hallertau have been for the three years 1924-5-6. German brewers have founded an Experimental Station for the study of the disease,† under the direction of Dr. Hampp (of the Weihenstephan Institute), at Hull, near Wolnzach, in the centre of the Hallertau district. Detailed reports on the occurrence of the disease in 1926 have been as follows: Hallertau (Pfeffenhausen)—The appearance of the disease was noted by May 1, and on June 28 it was reported that the attack was general, and was notably more violent than last year; in the Nandlstadt district approximately one-tenth of the acreage of hops was affected with the disease. At the end of July, damage was reported in the hop gardens round Mainburg, Wolnzach and north of Pfaffenhofen. More serious still were the attacks in the districts round Au, Nandlstadt and south of Pfaffenhofen, where the majority of the gardens suffered; the cones were attacked and often remained small and stunted. At Hersbruck, the disease was observed by June 12; reports from Ottensoos in October stated that the early varieties had been attacked, with the result that the cones were incompletely developed and "spotted." The disease was also stated to be present "everywhere more or less"

* This JOURNAL, XXXI, 1114 (1925); XXXII, 30 (1925); and XXXIII, 149 (1926).

† *Le Petit Journal du Brasseur*, XXXIV, 1113 (1926).

in the district of Speickern. Here and there in the Spalt district the Hallertau variety was attacked in August just as it was coming into hop. At Wassermungenau the disease was observed to be present in many of the hop gardens by June 14, and the hop leaves were reported as being spotted, as though marked by "rust." At Rottenburg (Wurtemburg) it was found in June, following a wet period, that most of the gardens were affected. The disease was also reported from Franconia (Gebirg).* C. Vermeulen has stated† that the disease appeared in the Hallertau district in 1924 and reappeared in 1925, during the latter half of the harvesting of the crop, owing to very rainy weather. It is also stated that different varieties of hops show varying degrees of susceptibility and that the Hallertau variety seems to be by far the most susceptible. Dr. F Merkenschlager has asserted‡ that, both in 1924 and in 1925, certain varieties of hops (the names of which are not given) grown in Germany, proved "immune" and that a great demand has arisen for these varieties. The statement as to the existence of resistant German varieties is also made by Prof. Korff, who remarks, however, that there is as yet insufficient experience on the point. As a rule the early varieties are only rarely attacked.§

France.—It is stated that the disease has invaded several districts in Alsace, also that it has damaged the crop in the districts round Hazebrouck ||

Czecho-Slovakia.—The disease is reported to have occurred in the south and south-east districts of Saaz.¶

Belgium —In June, the Belgian Minister of Agriculture officially reported the occurrence of the disease in the East of Brabant and recommended that control measures should be taken at once M l'Abbé A. De Jaeger, Secretary of the Fédération Houblonnière du Pays de Poperinghe, reported at a conference held in June that the outbreaks of the disease in Belgium were causing grave anxiety. A new variety ("Précoce") is stated to have proved somewhat resistant to both mould and downy mildew.** The Hallertau variety, when grown in Belgium (at Poperinghe) has proved very susceptible to the downy mildew.†† One result of the occurrence of the disease in England has been a petition in Belgium to prevent the importation of dried English hops of the 1924 crop, partly on the ground that the fungus might thereby be imported also. In a question addressed to the Minister of Agriculture in the Belgian Parliament by a deputy from Alost, the state-

* *Le Petit Journal du Brasseur*, xxxiv, pp 613, 771, 803, 870, 871, 935, 1073, 1116, 1117, 1307 (1926).

† l.c., p. 814 (1926).

‡ Merkenschlager, F.: "Bemerkungen zu den neuen Hopfenkrankheiten": (in) *Allg. Brauer u. Hopfen Zeit.*, n. 36, Feb., 1926. Reprinted in *Le Petit Journal du Brasseur*, xxxiv, 221 (1926).

§ Prof. Dr. Korff: Der falsche Mehltau des Hopfens: (*Bayerische Landesanstalt fur Pflanzenbau u. Pflanzenschutz*, Munchen, Flugblatt n. 47 (1926).

|| *Le Petit Journal du Brasseur*, xxxiv, 869, 1145, 1377 (1926).

¶ l.c., p. 1145.

** l.c., pp. 919, 925. *See also* pp. 1270 and 1339 for other references to the occurrence of the disease in Belgium.

†† l.c., p. 1029.

ment was made that in 1924 the disease attacked a great part of the English crop of hops.*

Jugoslavia.—It is reported† that the disease had been observed at Sachsenfeld (Zalec) in 1924 and 1925, and that it occurred also in 1926. The late varieties of hops were reported to be attacked at Sanntal (Zalec).

Occurrence of Downy Mildew in England.—*On the Growing Bine.*—In 1926 the downy mildew of the hop first came to the writers' notice on March 26, in the experimental hop garden of Wye College, where a single short "spike"-like shoot was found growing from the rootstock of a hill, as shown in Fig. 1. This "spike" was cut off and examined microscopically; the spawn (*mycelium*) of the fungus was traced internally down the stem and into a portion of the crown, where it was plentiful in the cortex and occasionally in the bast. It was detected also in the interior of the young expanded leaves borne by the "spiked" shoot. No spores had yet been produced, but on the "spike" being kept in moist air in the laboratory, these were produced in abundance by March 30. The first "spike" producing spores in the open at Wye was found on April 6.

A letter received from a hop grower (conversant with the disease) at Paddock Wood, Kent, reported that he had observed "spikes" in his hop gardens on March 31, and that, by April 8, they were to be found "here and there in all the early and midseason varieties."‡ Specimens of "spikes," obtained from a garden of Bramlings, were received in April from a farmer near Tonbridge, who wrote on May 10: "We are pulling out these 'spikes' for the second time; we find mostly one or two in a hill, but some hills have three or four."

The production of "spiked" shoots continued during May, and, by the 18th of this month, secondary infection, in which the fungus produces well-marked angular spots on the leaves,§ was well established in certain hop gardens. This spread of the disease is caused by the spores produced in damp weather on the surface of the "spikes" and on their leaves. Fig. 2 is a photograph of a hill which produced a large number of "spikes." It is most important, in order to control the disease at the start of the season, that the "spikes," produced in April and May direct from the crown of the hill,|| should be detected and pulled out and burned. This is the first infectious stage of the disease.

At the end of May and during June and July, the attacks of the downy mildew, on apparently healthy bines, trained up, were observed in many hop gardens in Kent. The result of the attack is the development of "spiked" tips and laterals, the leaves of which become so infected with the fungus that, in damp weather, their under-surfaces are more or less blackened by the production of the dark masses of spores. This is the second infectious stage of the disease. The appearance of these

* *Le Petit Journal du Brasseur*, pp. 581, 1208, 1305, 1338 (1926). This statement is not correct; the disease, if it occurred at all in the English 1924 crop, was extremely rare, and the crop as a whole was quite unaffected.

† l.c., p. 905.

‡ Shoots of the late varieties were not yet sufficiently forward to show whether they were diseased or not.

§ This JOURNAL, XXXI, 1144, Fig. 3 (1925).

|| These "spikes" may be termed "basal spikes" in contradistinction to the "terminal leafy spikes" produced at the tips of otherwise healthy bines.

FIG. 1. Downy Mildew of the Hop. One healthy shoot (*left*) and one diseased "spike"-like shoot (*right*). Such "spikes," recognizable by their silvery colour and permanently stunted growth, should be consistently removed from the time of their first appearance. (1½ nat. size.)

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Fig. 2. Downy Mildew of the Hop. A hill showing a large number of short "spike"-like shoots, together with several normal young bines, arising from the rootstock, May 21, 1926. ([illegible] nat. size.)

FIG 3 —Downy Mildew of the Hop A branch of hops (variety Cobbs) showing discoloration caused by the fungus (Compare *Fig* 4) Small angular spots are present on the leaves these provide an additional means of recognition of the disease (About ¼ nat size)

FIG 4 Downy Mildew of the Hop A branch of hops (variety Cobbs) healthy and of good colour (About ¼ nat size)

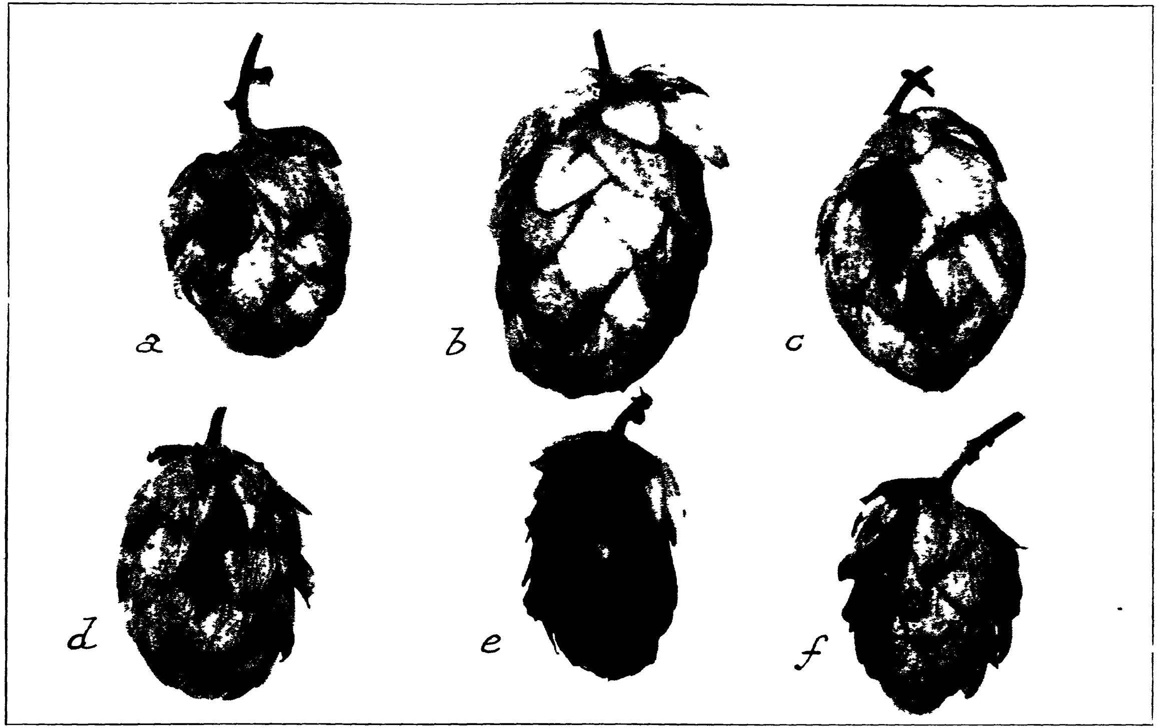

Fig. 5.—Downy Mildew of the Hop Cones showing the effects of attack in varying degrees. Certain petals only, of *a*, *c*, *d* and *f* have been turned brown (sometimes in vertical rows). One cone (*b*) is healthy and of good colour and one (*e*) has been turned completely brown by the fungus. ($1\frac{1}{4}$ nat. size.)

leafy "spikes" has been fully described and illustrated in a previous article.* It will not be without interest, however, from the practical side, to describe certain cases which were observed in 1926.

On June 1, a farm in the parish of Chilham, Kent, was visited. The garden of two and a-half acres was planted with the Tutsham variety, the plants being about ten years old. In the part of the garden worst affected, 25 per cent. of the hills showed the disease. Many of the bines had already been trained up, and in the case of the diseased hills, one or more of the bines had developed, at three to four feet from the ground, the characteristic "spiked" tip. The leaves of these "spikes" were producing spores in such profusion that on a "spike" being tapped sharply, the spores were dispersed in a visible cloud through the air. The diseased hills were also producing basal shoots, some "spike"-like and others of the leafy type.† A few leaves, low down on healthy bines, were found with reddish, angular spots, showing that secondary infections were taking place. The farmer was confident that this was the first time that his hop garden had shown diseased bines and no trace of disease had been noticed on the hop cones in 1925.‡ The work, carried out by women, of pulling out by hand all the affected shoots. was already in progress together with that of "cleaning" the hills and "stripping" the bines up to one foot from the ground. It may be mentioned here that the control measures adopted through the growing season, *viz.*, the removal of all "spikes" that were successively produced, the "stripping" of the bines gradually to just above the breast wire and the removal of lateral shoots from the "stripped" bine, the "cleaning" of the hills by removal of shoots and runners, were carried out under the supervision of the farmer and were successful. Complete control of the disease was obtained ; all the hops were picked from the garden in a perfectly healthy condition, the colour being very good indeed. On this farm, "spikes" were observed in all the other gardens (Bramling, Cobbs) ; the same control measures were adopted and in no case did the disease appear on the cones. The results obtained on this farm are particularly interesting when it is remembered that, as described below, the hops in other gardens in Kent (some in the same district) were seriously attacked by the disease.

On June 7 a garden near Canterbury was visited, where the varieties Eastwell Golding and Amos' Early Bird are grown. The same production of "spikes" was observed, and here again secondary infections were just starting. The farmer and his bailiff were very sure that diseased bine had not occurred in 1925 and no injury to the cones had been observed that year. Adjoining one of the affected gardens was a new garden of Eastwell Goldings planted in 1925 with rooted sets. Several basal "spiked" shoots were found on these plants, suggestive of the sets having been diseased when planted.

On the same day another garden, of the Bramling variety, in Chartham parish was visited. Many of the hills had produced bines, about three feet long, terminating in a leafy "spike" which was often black with myriads of spores of the fungus. The farmer, who was constantly in this garden throughout the growing season, was confident that the disease had not been present previously, nor had the cones been affected in 1925. The garden was in an isolated position. After inquiry whether "wild" hops existed in the vicinity, we were shown some of these growing in a hedge adjoining the hop garden. These "wild" hops were found to be

* This JOURNAL, XXXIII, 149, Fig. 4 (1926).

† This JOURNAL, XXXIII, 149, Fig. 2 (1926).

‡ So far as was known it was the first appearance of the disease anywhere on this farm.

thoroughly diseased, a dozen or more basal "spiked" shoots full of the fungus being visible. The appearance suggested that the plants had been infected for a number of seasons.*

In the case of a "wild" hop growing in a hedge at Bickington, Devon, "spikes" have been observed for three years in succession. This fact is suggestive of the permanence of the disease in one spot.

Other cases where "spiked" bines were produced occurred in gardens in the parishes of Cranbrook, Cuxton, East Malling, and East Peckham, in Kent, and at Farnham, Surrey—the varieties affected being Cobbs, Rodmersham Golding, Tutsham and Bramling.

Investigations again showed that, where "spikes" are produced at the tip of trained-up bines, five to seven feet long, the pith is turned brown in that part and contains the spawn (*mycelium*) of the fungus. The spawn, however, is not continuous downwards, and in most cases is absent at the place where long lateral shoots develop after growth of the main bine had been stopped. Removal and burning of diseased "spikes" and the training up of healthy laterals is, therefore, the course which is still to be recommended.

Occurrence on the Hop Cones.—At the beginning of hop-picking in 1926 the sudden and severe infestation of many gardens by "mould" (both "red" and "white"), coupled in some instances with attacks of the downy mildew on the cones, led to somewhat alarmist statements being made in the Press† and elsewhere. The investigations which we made in Kent in the worst affected districts showed that "red mould" was the agent responsible in most cases for the browning of the hops and for the leaving of many acres unpicked.‡

* It is, apparently, not uncommon for "wild" hops in the hedges and by the roadside to show the "spike" form of the disease. On May 25 it was observed that "wild" hops by the roadside at Crouch, near Borough Green, Kent, were badly diseased and had produced both basal "spikes" and "spiked" tips of shoots at about five feet from the ground.

† *e.g.*, in the *Morning Post* of September 6: "Many hop growers are alarmed at the appearance of a mysterious disease. At Matfield (Kent) over 40 acres of promising hops have been completely ruined as the result of mould, and an outbreak of the mildew is reported to have occurred at Biddenden, also in Kent. There, vast quantities of healthy hops were suddenly attacked, and within a fortnight turned brown and were absolutely spoilt."

‡ "Mould" in hops is caused by a fungus known as *Sphaerotheca humuli*, one of the so-called "powdery" mildews. In one form it is called by the farmer "white mould" and in another "red mould," but the two forms of the disease are caused by one and the same fungus. "Mould" is seasonal in character, being very bad in some years and slight or absent in others. As has repeatedly been pointed out, the disease can be prevented comparatively easily by sulphuring early in the season. A full description and a detailed account of the preventive measures that should be taken are given in the Ministry's Miscellaneous Publication No. 42 (1925), price 2s. 6d. post free, and in a leaflet obtainable from the South-Eastern Agricultural College, Wye, Kent. Reports received from farmers, who make a regular practice of sulphuring their hops in the "burr" stage or earlier, show that, even in such a bad season for "mould" as 1926 proved to be, hops can be grown free from "mould" at picking time.

The first case* investigated of downy mildew attacking the cones was on August 26. In the affected garden (Bramling variety, five acres, Yalding) some of the hops on hills, distributed here and there throughout the garden, showed "petals" turned dark brown by the attacks of the fungus. The appearance of the hop cones was similar to that shown in Fig. 5 (a, c, d, f). "Red mould" was also present to about the same extent, often occurring on the same bines. The actual damage caused by the downy mildew was inconsiderable in this case, but the presence of the two diseases was causing the farmer to pick the hops before they were ripe.

One of the most serious cases—and one of the most remarkable from the sudden appearance of the disease—occurred at Goudhurst in a garden of the Meopham variety. On August 20, the cones were noticed by the farmer to be "speckled with brown" and it was stated that this discoloration came suddenly and was not visible on August 19. Although the hops were not quite ripe, a start was made with the picking on August 30, but after a portion of the garden (about 1,000 hills) had been picked, the picking was discontinued on account of the disease having increased to such an extent that the hops had turned brown and were ruined for the market. At the time of our visit (September 1) the hops left were badly discoloured and the general appearance of the crop was as though it had been scorched. The effect of the disease on the cones was similar to that shown in Fig. 3. Although "mould" was present to a slight extent, this was not responsible for the general browning that took place. The affected Meopham garden had been planted 42 years, and here and there a hill of the Fuggles variety had been planted. The Fuggles were less severely attacked; the cones were greener, but nevertheless were frequently spotted with brown, due to the attack of the downy mildew. The farmer had never experienced the disease before, and had no knowledge of any "spikes" having occurred in the garden during the growing season. Adjoining the Meopham garden was a small garden (about two acres) of Bramlings, grown from sets planted in 1926. Angular spots caused by the downy mildew were present on the leaves, and the fungus occurred also on some of the few cones that were present; no "spikes" were observed. Outbreaks of the downy mildew were known to have occurred in neighbouring parishes.

Another case of a sudden and severe infestation occurred in Marden parish. A six-acre garden of the Tolhurst variety was attacked by the downy mildew, which turned the hop cones brown. The farmer stated that the disease came on very suddenly—"the browning occurred within one day." The hops were entirely discoloured. A little "red mould" was present also, but the downy mildew was responsible for the general discoloration of the crop. Most of the garden was picked, however, and the farmer reported that the colour improved on drying. This garden was interplanted with young Fuggles, and this variety was less severely attacked. An adjoining garden of Fuggles, with only an alley between, was hardly damaged, only a "petal" of the cones here and there being discoloured.

Another garden, of the Tolhurst variety in Staplehurst parish, was also found to be attacked by downy mildew. The farmer wrote: "Some say it may be due to the storm we had a time back, but I cannot think it is that, as there are a few Fuggles intermixed and also Fuggles adjoining (with only a broad alley between) and they are all quite all right." This garden was visited on September 8. About one acre of the Tolhurst garden had been left unpicked, and the cones were very brown from the attacks of the downy mildew. The cones of the Fuggles, growing intermixed, were only slightly affected. The same was the case

* In all cases described, the hop gardens were in Kent.

with an adjoining garden of Fuggles, and with another garden of Fuggles in close proximity; the hops were of a good colour, but here and there the downy mildew had turned a few "petals" brown.

A farm was also visited, on the same date, in Brasted parish, where a garden of two and a-quarter acres of the Henhams variety had been badly attacked. Picking was nearly finished; the bins contained brown hops badly affected with downy mildew. A few were as badly diseased as the cone shown in Fig. 5 (*e*). A slight attack of "red mould" was present also. About 10 per cent. of the hills were interplanted Fuggles, and the cones of these, according to the farmer's statement, had remained healthy. In the hedges by the side of this hop garden "wild" hops were found attacked by the downy mildew. Dried hops from the Henhams garden were shown to us on the floor; their colour was not so bad as might have been expected from the brown appearance of the hops in the bin.

On September 10 some branches of brown hops from a two-acre garden of Tolhursts were received from a farmer at Biddenden. Examination showed that these hops had been turned brown from the attacks of the downy mildew. The farmer wrote: "Three weeks ago, or just before that severe storm on Monday, the hops looked as well as possible. The following week the hops were brown, but mostly on the side exposed to hail. Fuggles in the same garden are all right." This farm was visited on September 12. The Tolhursts had been picked and the two acres of Fuggles in the same garden were being picked. The cones of the latter were of a good colour, although here and there one or two "petals" on a cone were attacked by the downy mildew and flecked with brown. A similar slight attack on Fuggles was found in another garden about a quarter of a mile distant.

Two other farms at Biddenden were visited. On the first a garden of Tolhursts (three and a-quarter acres) had been attacked by the downy mildew and the cones on one and a-quarter acres had been turned brown. We were told that "the garden went off like this in 48 hours." It was also reported that the colour of the browned hops improved greatly on drying. On the second farm, in a garden of Tutshams of about five acres, the cones were rather badly browned; "red mould" was the chief cause, but here and there the downy mildew occurred on the cones.

A farmer at Benenden reported that the cones on two acres of Tutshams looked so brown, when picked and lying in the bins, that he sent a sample (after drying) to his London factor to inquire whether he should continue picking. He was told that his sample was better than most received that season. Here again the surprising improvement in colour was noted. A box sample of the dried hops was obtained and examined microscopically. "Red mould" was present and accounted for the brownest "petals," but downy mildew also occurred to a slight extent.

A garden of five acres (probably of the Tolhurst variety) in Matfield parish was visited. Three acres of this garden were left unpicked, and here the cones were completely brown. "Red mould" was abundantly present, with here and there a trace of downy mildew.

Attacks of downy mildew on the cones were ascertained and confirmed in the following parishes:—

KENT.—*Goudhurst:* a trace of downy mildew on the cones in a garden of Tolhursts. *Iden Green:* the cones in a garden of Tutshams (five and a-half acres) were turned completely brown and ruined and the garden was left unpicked. "Red mould" was the main cause of the damage, but the downy mildew had turned the cones brown on some hills here and there. *East Sutton:* a five-acre garden of Cobbs was

badly attacked by "red mould," with downy mildew on a few cones here and there. *Paddock Wood:* in a garden of Tutshams a trace of downy mildew was present on the cones, but the main cause of damage was "red mould." *Chartham:* the farmer wrote: "I went round all my grounds, I think, four times, and in the worst cases five, and pulled and burnt the 'spikes.' Rodmersham Goldings seem rather more subject to it than the others. This pulling was mainly done in May, but I think extended into June in the case of late-growing bines. At the last pulling there were a few cases of 'spikes' growing on bines about breast-high, which had to be broken off. I had a sprinkle of 'red mould' in certain grounds at the time of picking, but in the grounds worst affected with the 'spikes,' and where the bine was rather 'housy' at the top, there is no doubt I had patches of downy mildew. This caused me considerable apprehension early in the picking, but I was able to pick all my hops, the downy mildew not having spread as I had expected, probably on account of the dry weather in the last fortnight of picking. At the commencement of September we had three foggy and damp days, which I think caused it to start in the cones." *Wye:* cones were attacked and turned brown in a garden of Eastwell Goldings. The grower wrote: "The downy mildew did affect the appearance of the sample, but was to some extent masked by the drying. It was sufficient to convert a first-class sample to an ordinary good sample." Outbreaks on the cones also occurred in the parishes of *Harbledown* near Canterbury, and *Five Oak Green* near Tonbridge.

SUSSEX.—*Wadhurst:* cones were received on September 11 from a garden of Tolhursts and the sender reported: "This garden has gone off from the green stage to the present state since last Wednesday, September 8. In this district we find Tolhursts are the worst affected." The hops were almost completely brown and were attacked to about an equal extent by "red mould" and downy mildew. In a Tutsham garden in the same parish, the cones had been turned brown; "red mould" was abundant and was probably the main cause of the damage, although downy mildew was present on some of the brownest "petals." Hop cones, speckled brown by the attacks of downy mildew, were also received from gardens of Fuggles and Tolhursts. The discoloration was attributed to storms, rain and sunshine. In another garden (variety not specified) in the same parish, the cones had been turned brown, and downy mildew and "red mould" were present to about an equal extent. *Ticehurst:* cones were turned brown in a garden of Tolhursts. This was caused by a bad attack of "red mould," with some downy mildew intermixed; one and a-quarter acres of this garden were left unpicked. In a garden of Tutshams the cones had been attacked by downy mildew and turned brown, a little "red mould" being also present. Three gardens of Fuggles in the same parish were also attacked. In the first the farmer had noticed, at the time of "dressing," that "the shoots came away very spiky"; the cones were more or less brown; "red mould" was present in addition, and less than half the damage was due to attacks of downy mildew. In the second garden the brown colour of the cones was due to attacks of "red mould" and downy mildew in about equal proportion. In the third garden the farmer stated: "A few days ago these hops were very green and now they are going off very quickly." The brown hops sent showed that most of the damage was due to "mould," some of the cones being white with this fungus, others foxy red ("red mould"). A few cones occurred in which the "petals" were dark brown, due to attacks of downy mildew. *Etchingham:* the sender wrote: "A portion of this garden (variety not specified) is left entirely unpicked." Examination showed

that the main cause of the damage was downy mildew, although "red mould" was also present.

HAMPSHIRE.—*Selborne*: the cones were attacked in gardens of Tutshams, Cobbs and Fuggles. The grower wrote: "I have gardens totalling 60 acres, all of which are infected—only two (some 10 acres) badly. In every case but one, 'red mould' is also present. The curious thing, in our experience of downy mildew, was that there was no sign of it until September 1—two days before picking. No 'spikes' were observed at any time." The cones that were sent showed the presence of downy mildew.*

In some of the above cases the farmer reported that the disease had not been noticed in the hop garden before the hops were ripening. It may be doubted, however, whether the disease had really been absent, as experience has shown that until the farmer has learnt to recognize the appearance of the fungus, as it occurs on the leaves and "spiked" growths, the disease in this form easily escapes notice. When once recognized, "spikes" are never again passed over. Had the disease been noticed earlier in the season and treated on the lines mentioned later, there is every reason to believe that the attacks on the cones would have been prevented or, at least, their severity greatly reduced.

As regards susceptibility to attacks on the cone, the outbreaks in 1926 appear to give some evidence that the Tolhurst variety is decidedly susceptible, while Fuggles is to some extent resistant. Observations made by Mr. J. Amos at the Research Station, East Malling, and by the writers at Wye show that the cones of different varieties exhibit varying degrees of susceptibility to attacks of downy mildew. To what extent this may be due to the weather conditions at the time of cone development (which latter depends upon the variety concerned) can only be estimated after further observation.

Life-History of the Fungus.—In previous articles† the writers have pointed out that the fungus produces spores throughout the growing season on the leaves, surface of shoots, and on the cones. These spores spread the disease through the hop garden. The fungus produces also "winter spores" (*oospores*) in the leaves, in the stems of "spiked" shoots, and in the "petals" of the hop cone. These resting spores, in all probability, remain alive through the winter months and reinfect the young leaves during the following spring; their germination, however, has not yet been observed. There is another way in which the fungus may persist in a hop garden once attacked. We have obtained further proof of the existence of "spawn" (*mycelium*) of the fungus in the rootstock of the hop.

In April, 1926, a microscopical examination was made of several diseased hills in the experimental hop garden at Wye. In the first case, the hill bore two "spikes"; these were removed with the adjoining part of the rootstock and examined.

* Examples of browned hops suspected of having been attacked by downy mildew were received from Ledbury, Herefordshire. Examination showed, however, that "red mould" only was present.

† This JOURNAL, XXXI, 1114 (1925); XXXII, 30 (1925); and XXXIII, 149 (1926).

Mycelium was found in one part of the 1925 growth, which had been "dressed" and from which the "spikes" were growing. Here it was very localized and was confined to the cortex immediately around the points of origin of the two "spikes." The localization of the mycelium was so complete that all tissues on the other side of the "dressed" stump of 1925 growth were healthy, and gave rise to healthy and strong-growing bines. In the second case, sections of the part of the hill removed showed mycelium penetrating three inches into a one-year-old part (a dressed stump of 1925 growth) projecting from the hill. Although mycelium was thus present in such parts of the rootstock, both the shoots and buds which were at that time arising from the infected areas were found to be free from mycelium. As many as six shoots, each about four inches long, were found healthy on an infected one-year-old part of the hill. Another portion of the same rootstock contained mycelium, extending continuously from the "spiked" growths through the one-year-old parts and into the older portions of the rootstock. In this case it was found that buds only one-eighth of an inch long were invaded by mycelium, and many buds were found brown and dead. A third hill examined showed the fungus present in the rootstock. One bud, situated between two "spikes," and a quarter of an inch long, was permeated by mycelium.*

There appears to be evidence that hills, which show "spiked" growths in one season, are not necessarily diseased in the rootstock at the commencement of the following season. The writers have recorded a case where, in 1925, in a garden of Tolhursts, 70 per cent. of the hills became diseased and produced "spiked" growths when the bine was five to seven feet high. During February and March, 1926, nineteen of these hills were grubbed up and examined microscopically.† These hills came from the worst affected part of the garden. No mycelium was found in the crowns of the rootstock or elsewhere, or in the young shoots which were numerous on each plant and up to three inches long. Further, eight hills which had produced basal "spikes" in 1925 in the experimental hop garden at Wye

* Further details concerning the hibernating mycelium will be found in a paper by W. M. Ware: "*Pseudoperonospora humuli* and Its Mycelial Invasion of the Host Plant." (*Trans. Brit. Mycol. Soc.*, XI, 91-107, 1926.)

† This JOURNAL, XXXIII, 149 (1926). These plants included the two diseased hills shown in the photograph, Fig. 3, and the rest came from within a radius of ten hills from these.

were examined in January, 1926. No mycelium was found in the sets or runners removed in the process of "dressing," or in older portions of the rootstock which were examined in two cases.

Five hills in the same garden, the hops of which had been so badly attacked in 1925 that they could not be picked, were examined in January, 1926. No trace of mycelium was found in the sets or runners.

During the season of 1926 it was noticed that several male hop plants growing in the hop garden at Wye were severely attacked by the downy mildew. Male plants (re-flowering) were examined on September 3. Fructifications and spores of the fungus were found on the perianth lobes of many flowers, though there was no great discoloration; also on the perianth of flowers which were still closed. Resting spores (*oospores*) were plentiful in the perianths. The attack on male hops is obviously a point of possible economic importance; if they became badly diseased in a commercial garden the pollen necessary for fertilizing the surrounding "burr" would not be produced. The following interesting note was sent to us by a farmer. Two male hop hills (growing in a hop garden) were observed to send up at the commencement of the season only "spiked" bines. These were "pulled." Some apparently healthy bines were next produced and were trained up, but these, when about breast-high, developed "spiked" tips and were then pulled up. Further bines were produced and trained up; these remained healthy, reached the top wire and flowered.

Consideration of Control Measures.—In view of the fact that, in 1926, the downy mildew caused serious injury to the hop cones in several gardens in Kent and adjoining counties, it becomes imperative to discuss what are the best measures likely to control the disease. It must be pointed out that this attack on the cones occurred in gardens where the disease had never before been seen by the farmers, and where no precautionary measures had been taken. It appears that a gradual upward spread of infection takes place, during the latter part of the growing season, until the leaves of the lateral shoots, in close proximity to the hop cones, become spotted with the fungus in its spore-producing, infectious stage. Then, during periods of rain or mist, the fungus quickly spreads from these leaves to the cones, and the crop on bines, the leaves of which, to the unpractised observer, appear to be healthy, suddenly becomes blighted. It is rather unlikely, in the case of

the downy mildew, that the spores (being relatively heavy) are blown from one garden to another,* although, of course, the disease may easily spread from bine to bine, the spores being carried in drops of water or blown a short distance by the wind.

The infection of the upper leaves is gradual and probably proceeds by means of spores produced on the lower leaves or on the "spiked" growths. The main sources of infection each season (excluding the winter spores, about which nothing in this respect is as yet known) are the "spikes": (*a*) basal "spikes" produced direct from the crown of the hill and (*b*) terminal "spikes" produced at the tip of apparently healthy bines when these are about breast-high. Both these kinds of "spikes" are prolific sources of infection, dense masses of spores being produced on them for a considerable length of time. Spores spread from them to the leaves of healthy bines, and the infection climbs, step by step, to the last-produced leaves among the hop cones, there to give rise, under suitable weather conditions, to disastrous attacks on the cones. By the continued collection and destruction of all "spiked" growths, it appears practicable to restrict the production of spores so that the upper leaves do not become infected to any serious extent, and consequently the cones remain unattacked. Equally important is the removal of the lower leaves from the bine as early as possible; experience has shown that soon after the appearance of the basal "spikes," secondary infections take place and the lower leaves of adjacent healthy bines become infected. These latter must be removed, the bines being "stripped" in stages; otherwise such leaves serve as a ladder for the upward climb of the fungus. Further, later in the season, any lateral shoots that arise from the "stripped" part of the bines, and any fresh shoots and runners that arise in the hill, must be pulled out or hoed off. In an infected garden, no green leaf should be found between the ground and the breast wire. The existence of any leafy shoots, low down, provides a place of establishment for the fungus.

A case in which these preventive measures were successfully carried out has been described above (p. 1111). A further instance may be mentioned now. In 1925, in the experimental hop garden at Wye College, there was a slight general attack on the cones and, in certain hybrid seedlings, the hops became so discoloured that they were useless for picking. In 1926, the

* In the case of "mould," the fungus (*Sphaerotheca humuli*) produces spores which are extremely light and these are carried by the wind for distances of a mile or more.

garden was carefully searched for "spikes" three times during the season, *viz.*, in May, June and July. Both basal, lateral and terminal "spikes" were found on a number of hills and were removed. At picking time, the garden as a whole was practically free from the disease and the hills on which cones were destroyed in 1925 (and in some cases in 1924) bore a crop of perfectly healthy hops.

The instances of successful prevention of the disease in 1926 are particularly encouraging in that there can be no doubt, from the cases already recorded above, that the season was most favourable for the attacks of the fungus on the hop cones. Below, are given the control measures which the writers consider essential to be taken in hop gardens affected with downy mildew. With regard to nursery beds, the fact has been confirmed that attacks by the downy mildew, causing angular spots on the leaves, during late summer and autumn are extremely common. It appears not improbable that the rootstocks of such plants, or the buds on them, become infected by the spores falling from the infected leaves. It is to be feared that, at the present time, hop gardens are commonly being planted up with diseased sets. By the use of Bordeaux mixture on nursery beds, it may be possible to raise healthy sets. At present, however, the majority of farmers have not yet learned to recognize the disease on the leaves, or, when they do notice the reddish-brown angular spots and the curling of the margins, some are disinclined to believe that these are symptoms of disease and stoutly maintain that they are merely signs of "ripening off."

Control Measures.—(1) From April or May onwards, the "spiked" shoots arising direct from the crown of the hills must be searched for and removed. (2) "Stripping" of the lower leaves of the bines should be carried out as soon as this operation will not prejudicially affect the growth of the bine. Proceeding stage by stage, the leaves should be removed to a height of five to six feet. (3) Should the trained-up bines showed "spiked" tips during June or later, these tips should at once be cut off and burned, and the same treatment applied to any "spiked" lateral branches that occur. The healthy laterals which arise below the "spiked" tip of the main bine may safely be trained up. (4) Where the hop cones are attacked, these, if left unpicked, must be cut down and burned. It is also advisable that the whole of the bine in the garden should be collected and burned as soon as possible after

hop picking. (5) All "wild" hops, growing in the hedges or waste places adjacent to the garden, must be grubbed up and destroyed. It has been found that such hops harbour the fungus. (6) In districts still free from the disease, it is advisable that growers should raise their own sets rather than obtain them from an outside source.

There is good prospect that the disease can be more easily and effectively controlled by adoption of the above measures than by resort to spraying. The latter is not at present recommended.

Summary.—(1) An account is given of the continued spread of the disease abroad, and of the serious damage it has caused to the hop crop on the Continent.

(2) In 1926 outbreaks of the downy mildew occurred on the hop cones in a number of gardens in Kent and adjoining counties, in a few cases ruining their colour to such an extent that the hops were not picked.

(3) As regards attacks on the cones, the variety Tolhurst proved, under the conditions of 1926, to be very susceptible and Fuggles more resistant.

(4) Cases are recorded where the "spiked" growths, caused by the fungus, were systematically removed from the hop garden and the spread of the disease to the cones prevented.

(5) Confirmation has been obtained (*a*) that the lateral shoots produced below the "spiked" tips of bines, five to seven feet high, are usually healthy and may, therefore, safely be trained up ; and (*b*) that the spawn (*mycelium*) of the fungus may be present in the rootstock of the hill.

(6) The flowers of the male hop may be seriously attacked.

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THE CONTROL OF APHIS ON BLACK CURRANTS

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IN a recent number of this JOURNAL* an account was given by two members of the staff of the School of Agriculture, Cambridge, of trials with tar-distillate washes in East Anglia. From the experiments therein described the general conclusion was that certain washes gave practically complete control of leaf-curling plum aphis and rosy apple aphis.

The following notes give an account of the very striking results obtained by the use of two of these sprays on black

* Vol. XXXIII, July, 1926, p. 332.

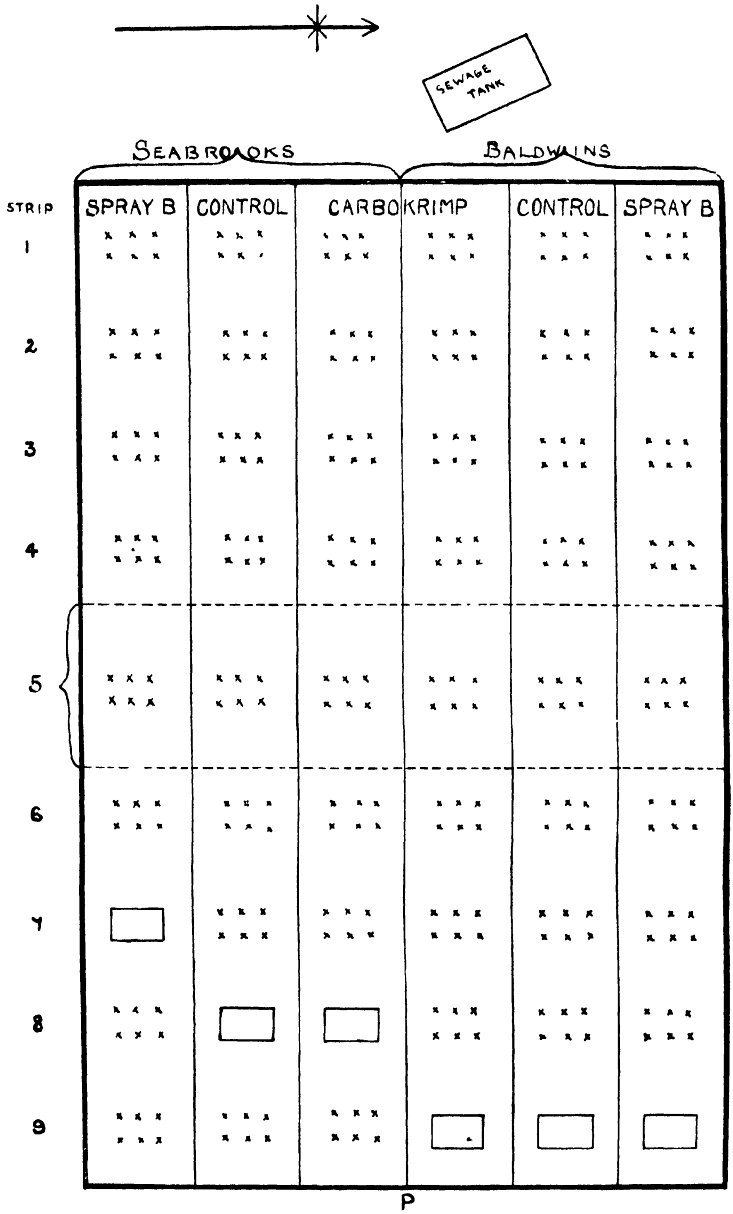
currants. Every grower is familiar with the great damage caused to black currants by attacks of aphides : if this damage can be obviated at trifling expense by the use of a suitable spray, the great financial gain hardly needs to be emphasized.

In 1923, it was decided to dispose of the Institute sewage by irrigation on a three-acre field which was then in permanent pasture. The first steps consisted in removing various trees and in ploughing and fallowing the ground. In the autumn of that year, one-year-old rooted cuttings of black currants were planted. As the ground was still far from clean, and irrigation with sewage encouraged the rapid growth of weeds, the planting was done at distances of 6 ft. × 6 ft. apart, in order to facilitate cross cultivation. Two varieties were used : Baldwin's Champion on half the area, and Seabrook's Black on the other half. These plants were all cut back in 1924. Meanwhile cleaning operations were continued until a very bad and dirty piece of ground was restored to a desirable state of good cultivation. In 1925, various tar-distillate washes were used, but there was no aphis attack that year. Very different was the experience in 1926, when very considerable damage was done all over the country. The repetition in this field of spraying with different washes gave the opportunity to record both the extent of the damage and the degree of control effected. As spraying was done with lime-sulphur, as well as with tar-distillate washes, and as there were two varieties of currants, the records obtained give information on—

(1) The control of aphis by certain tar-distillate washes.
(2) The value of lime-sulphur for the same purpose.
(3) The comparative cropping power of Seabrook's Black and Baldwin's Champion.

Particulars of the Experiment.—An examination of the accompanying plan (Fig. 1) shows how the experiment was carried out. Baldwins occupy one half of the field, Seabrooks the other. A strip down the middle of each variety was left untreated by the tar-distillate sprays, while on one side of each untreated strip Carbokrimp was used, and on the other side Spray B. In addition the whole field was treated with lime-sulphur except twelve rows in the cross strip shown as 5 in the plan. This control area was left untreated with lime-sulphur, in order to test the effect of this spray on aphis.

Spray B and Carbokrimp were applied on February 2, 5, 10 and 11 at 7½ per cent. concentration. This is possibly a greater strength than is necessary for black currants, 6 per cent. being held to be effective in some districts.



INDICATES THE PLOTS, 6 BUSHES IN EACH, FROM WHICH THE FRUIT WAS WEIGHED. ▭ INDICATES WATERLOGGED PLOTS. THE FIELD SLOPES FROM THE SEWAGE TANK TO THE SE CORNER.

FIG. 1.

FIG 2 —Showing general view of field (taken from point P on plan) showing black currant bushes sprayed in foreground and to the left unsprayed to the right and in right background

FIG 3 Black currant bushes Closer view showing sprayed bushes to the left, unsprayed to the right

The cross spraying with lime-sulphur was carried out, in the case of Baldwins, on March 1 and 2, at a strength of 1 in 12, and, in the case of the Seabrooks, on March 8 and 9, at the same concentration. With both varieties the leaves, at the time of spraying, were about the size of a half-crown piece.

Observations before Picking.—During March very little difference could be detected between the various plots, but early in April it was possible to pick out the controls, for there the aphis eggs were hatching out, whereas on the sprayed bushes they remained unchanged. As the season progressed the differences became more and more marked, and by June were most striking. At this time the control bushes were 100 per cent. infected and had made scarcely any growth; those treated with Carbokrimp were practically free from infection and were making vigorous growth; those treated with Spray B did not seem much better than the controls, being badly infected and making little growth. The difference between the bushes treated with Carbokrimp and the rest was so marked that it could be easily detected a quarter of a mile away. The control had a typical blighted appearance, while the sprayed trees were green and luxuriantly healthy. The photographs give some idea of this difference: Fig. 2 is a general view of the field (taken from point "P" on plan), showing sprayed trees in the foreground and to the left, and unsprayed trees to the right background; and Fig. 3 shows sprayed trees on the left, unsprayed trees on the right.

The Crop.—Before picking, it was evident that a much heavier crop would be obtained from the Carbokrimp bushes —and not only a heavier crop, but one of far higher quality. The fruit on the control bushes was small and sooty in appearance, whereas that from the sprayed bushes was clean and of first quality. Owing to the season the crop was nowhere very heavy, many of the berries having fallen off in the spring owing to frost and cold winds.

In order to get an accurate determination of crop yields under the various treatments, the field was divided into nine strips, as shown on the plan. Each strip ran across the various treatments so that defined areas were obtained, on each of which a plot of six bushes was marked out. When the currants were being picked, the total fruit from each of these plots

TABLE I

WEIGHT OF FRUIT FROM PLOTS OF SIX BUSHES

	Seabrooks						Baldwins						
	Spray B		Control		Carbo-krimp		Carbo-krimp		Control		Spray B		
	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	
Strip 1 ..	1	15	1	5	8	2	9	12	3	0	5	0	1
„ 2 ..	4	5	1	4	6	2	9	14	5	0	6	9	2
„ 3 ..	5	9	4	5	8	0	8	2	2	0	5	6	3
„ 4 ..	3	13	3	11	4	14	8	0	2	0	4	2	4
„ 5 ..	5	12	2	12	6	9	5	10	2	4	5	8	5
„ 6 ..	6	3	1	14	2	8	4	8	3	8	6	2	6
„ 7 ..	0*	15	1	2	3	2	4	9	2	3	4	2	7
„ 8 ..	1	9	0*	5	1*	1	3	8	2	11	5	8	8
„ 9 ..	2	13	1	12	1	4	3	4	1*	4	2*	10	9
Avg. of 8 plots ..	4	0	2	4	5	1	6	12	2	13	5	5	
P. error		+8		+5½		+10		+11½		+4¾		+4	

* These plots omitted from calculation owing to waterlogging.

NOTE.—In addition to treatment with tar-distillate sprays, all the strips except No. 5 were sprayed with lime-sulphur (1 in 12).

was weighed separately. These weights are recorded in Table I. In considering this table, it is at once apparent that there is a consistent falling off in yield from the higher ground to the lower. This may be due to the nature of the ground, but unequal manuring with sewage and indifferent drainage on the lower ground no doubt also contributed to this result. Before the winter of 1925-26, the bushes on certain of the lower areas made very poor growth until draining was effected, and for this reason the data from some of these plots have not been included in the averages.

Considering first the Baldwin variety, it will be seen that, without exception, the figures for the control plots are lower than for those sprayed on either side, and in every case the difference is a considerable one. Omitting bushes on the plots which had suffered from waterlogging, the averages are :—

Control	Carbokrimp	Spray B
2 lb. 13 oz.	6 lb. 12 oz.	5 lb. 5 oz.

In the case of the Seabrooks, a similar statement holds, *viz.*, that in every case the control is less than its neighbours on

either side. The yields, however, are lower and the differences less, the averages being:—

Control	Carbokrimp	Spray B
2 lb. 4 oz.	5 lb. 1 oz.	4 lb. 0 oz.

Expressing the crop on the control for each variety as 1, we get as the ratios for the two different sprays :—

	Baldwins	Seabrooks
Control	1	1
Carbokrimp	2·4	2·4
Spray B	1·9	1·8

These ratios are remarkably similar and we may express the results briefly in the statement: "Treatment with Spray B has increased the crop by nearly 100 per cent.; treatment with Carbokrimp by 140 per cent. In addition, spraying has raised the quality from third to first class." The effect on the crop produced by Spray B is very much greater than was expected as a result of earlier observation.

Cost of Treatment and Value of Return.—With such striking results, it is clear that even expensive treatment would, in the year of the trial, have far more than have paid for itself. Actually, however, the cost of the sprays and of the labour involved in application worked out at about 1d. per tree, or under £6 per acre. In Table II the figures of the average yields have been used to calculate the gross return per acre at three different prices per lb. Thus, in the case of Baldwins sprayed with Carbokrimp, *assuming a level price of 9d. per lb.*, the value of the crop per acre was £51 as compared with £21 for the crop on the unsprayed portion. Actually, if the quality were taken into consideration, the difference would be still greater. This is a handsome return for the expenditure of £6 per acre. Even in the case of the less effective Spray B, the cost is twice covered, although assuming only the low price of 6d. per lb. for the fruit. The value of these figures is, of course, linked with the frequency of aphis attacks and their after-effects; the latter may be very serious.

Effect of Lime-Sulphur on Aphis.—As has been previously stated, all the currants were sprayed with lime-sulphur, with the exception of those on Strip 5. Observations during the spring produced no evidence of the effectiveness of lime-sulphur at the dilution used (1 in 12) in destroying aphis. The control areas were consistently blighted whether they received lime-sulphur or not. The figures in Table I bear

TABLE II

SEABROOK'S BLACK

	Yield of 8 plots (48 trees)	Calculated yield per acre (1,210 trees)	Value per acre		
			At 6d.	At 9d.	At 1s.
	Lb. Oz.	Lb.	£ s. d.	£ s. d.	£ s. d.
Carbokrimp ..	5 1	1,021	25 10 6	38 5 9	51 1 0
Spray B ..	4 0	804	20 2 0	30 3 0	40 4 0
Control ..	2 4	454	11 6 10	17 0 4	22 13 9
Difference between Spray B and control ..	1 12	350	8 15 1	13 10 3	17 10 3
Difference between Carbokrimp and control ..	2 13	567	14 3 7	21 5 5	28 7 3
BALDWIN'S CHAMPION					
Carbokrimp ..	6 12	1,361	34 0 7	51 0 11	68 1 3
Spray B ..	5 5	1,066	26 13 1	39 19 8	53 6 3
Control ..	2 13	570	14 5 1	21 7 7	28 10 2
Difference between Spray B and control ..	2 8	496	12 8 1	18 12 2	24 16 3
Difference between Carbokrimp and control ..	3 15	791	19 15 7	29 13 5	39 11 3

out these observations. Throughout the series, with one exception, the weights from the plots in Strip 5 are intermediate between the corresponding plots in Strips 4 and 6. The crucial test is found in the control areas in Strip 5, where, had lime-sulphur been effective, a higher yield, equivalent to that obtained by one of the tar-distillate sprays, would have been expected. No such increase was found. The results quite clearly indicate that lime-sulphur, under the conditions which prevailed, had not the slightest effect in controlling aphis.

Future Observations.—As already mentioned, much more vigorous growth was made by the sprayed bushes, especially

those receiving Carbokrimp. Accordingly, it is to be expected that the benefits of the spraying will extend to subsequent years, and that the full monetary return is not represented by the first year's crop alone. It is, therefore, intended to weigh the fruit from the plots again this year, when the whole field will be sprayed with Carbokrimp.

Baldwins v. Seabrooks.—Seabrook's Black and Baldwin's Champion were originally planted to compare the returns of these varieties over a period of years, and it is interesting to record the comparative yields to date. Baldwin's Champion has given the heavier yields in other trials, but it is supposed to have a short life owing to its susceptibility to "big bud." On the other hand, Seabrook's Black is reputed to be a lighter cropper and to have a longer life in the east of England, owing to its resistance to "big bud." So far as "big bud" is concerned, the past two years at this Institute have provided little information, as on both varieties the incidence of this pest has been infinitesimal.

Considerable difference in cropping power is, however, apparent, and is clearly brought out in Table II. The results from the two years may be summarized as follows :—

	1925	1926
Baldwins	144	131
Seabrooks	100	100

The superiority of Baldwins in the first two cropping years is apparent, but the ultimate order of merit will depend on a number of factors which can only be determined by continuing the records throughout the life of the plantation.

Summary.—(1) Aphis on black currants has been effectively controlled by the use of Carbokrimp, less effectively by Spray B.

(2) Crop increases, as a result of spraying, up to 140 per cent. have been obtained at a trifling cost compared with the value of the increased crop.

(3) An effective tar-distillate spray contributed greatly to securing fruit of the highest quality.

(4) Bushes on which aphis was controlled made good growth ; thus the benefits from successful spraying will extend into subsequent years.

(5) Lime-sulphur, however useful as a precaution against "big bud," has not, in the circumstances described, proved of value against aphis.

COUNCIL OF AGRICULTURE FOR ENGLAND

THE twenty-third meeting of the Council was held at the Guildhall, Westminster, S.W. 1, on Thursday, January 20, 1927, LORD CLINTON being in the chair.

Elections to Agricultural Advisory Committee.—At preliminary meetings of the members nominated by the Minister, and of the members appointed by the County and Borough Agricultural Committees, respectively, the following members were re-elected to the Agricultural Advisory Committee:—Lord Clinton, Mr. George Edwards, and Lady Mabel Smith, by the Minister's members; Sir George Courthope, M.P., Mr. James Donaldson, and Sir Merrik Burrell, Bart., by the County and Borough members. In addition, the latter body elected Mr. James Hamilton (Lancs) to fill the vacancy on the Committee caused by the retirement of Mr. J. R. Spraggon (Durham).

Statement by the Minister of Agriculture.—The Right Hon. WALTER GUINNESS, M.P., in addressing the Council, reviewed certain of the more contentious aspects of agricultural administration and legislation in 1926. He referred to the embargo on foreign meat and to the position of foot-and-mouth disease, showing that in the first five months of the year there were 123 outbreaks as against 81 in the last seven months during which the embargo had been in force. The sugar beet industry had, from the agricultural point of view, proved a great success. It was estimated that in 1927 there would be 174,000 acres under sugar beet as against 130,000 acres in 1926. Fourteen factories had been operating in 1926 and there would be at least another two in 1927, whilst certain of the existing ones would increase their capacities. Complete yield figures were not yet available, but, from present information, it appeared that the average yield per acre had improved from 7·8 tons of beet, having an average sugar content of 16·36 per cent., to 8·8 tons of beet, having an average sugar content of 17·4 per cent. He was hopeful that this improvement would be continued and would enable the industry to adjust itself to the inevitable period of decreased prices which must come as the rate of subsidy declined and finally ceased. The subsidy per cwt. of white sugar would drop from 19s. 6d. to 13s. at the end of the next season of manufacture, remain at 13s. for three years, after which it would drop to its final level of 6s. 6d., remaining at that figure for a further three years, when it would cease.

The Minister then passed to a review of the legislation in 1926 dealing with the Small Holdings and Allotments Act; the Rural Housing Act; the Merchandise Marks Act; the Fertilizers and Feeding Stuffs Act, concerning which he said that the Government had had the good fortune to persuade Lord Clinton to become Chairman of the Committee set up under it; and the Horticultural Produce (Sales on Commission) Act. The Land Drainage Act and the Weighing of Cattle Act had both been considered by the Council in the previous year (1926). As to the legislation in 1927, it was too early yet to discuss details. He could, however, say that, apart from other objections, election pledges and the urgent need for economy would preclude the Government from adopting either tariff arrangements or subsidies to give the farmer an artificial increase in prices. The Government would continue on the lines of the White Paper, aiding the farmers as far as possible in helping themselves, and with the minimum of interference by the State. The industry at the present time needed a helping hand, not a charge of gunpowder.

Mr. J. S. GIBBONS (Glos.) asked how the cost of a County Council investigation into the proposed assisted purchase of a small holding would be defrayed. The Minister promised a reply on this point of administrative detail. Mr. W. B. TAYLOR (Norfolk), Sir DOUGLAS NEWTON, M.P. (Cambs.), Captain E. T. MORRIS (Herts), and Mr. H. W. THOMAS (Hants) asked questions arising on sugar beet and discussed them under that head with the Minister. Mr. CHARLES ROBERTS (Cumberland) asked whether it was possible under the Rural Housing Act for a County Council to get a Government grant in cases where they were assisting by way of loan only. The Minister undertook to pass this question on to the Ministry of Health, the proper authority to deal with it. Major HOTCHKIN (Lindsey) asked whether the Minister was satisfied that the responsible bodies would move at once in getting such goods as foreign eggs scheduled under the Merchandise Marks Act. THE MINISTER replied that he thought they would; the Committees to deal with such questions were practically set up already. Major HOTCHKIN also asked as to the interpretation of a point under the Small Holdings and Allotments Act in a case where the County Council gives notice to a small holdings tenant who is not living on the holding but working it in conjunction with a second holding—whether he could claim compensation for disturbance under the Act. The MINISTER replied that the question was a legal one on which he had no authority to give

an opinion. The general question had, however, been considered in both Houses of Parliament, and after hearing arguments on both sides it was felt to be desirable to leave the general law of compensation to apply to the small-holder as to everybody else.

Marketing of Pigs Report.—The Right Hon. Sir FRANCIS ACLAND, Bart., presented the Standing Committee's Report on the Ministry's Marketing of Pigs Report (No. 12, Economic Series). The Standing Committee called attention to the opportunity which was given for increasing pig production, through the embargo on fresh pork and mild-cured bacon. The Committee agreed with the Report, which suggested that the time had come when the various pig-breeding societies, bacon factories and other bodies concerned in the production and selling of pig meat should combine in a campaign to increase the supplies of pigs. It considered that the Pig Industry Committee, suggested in the Report, which would have, for its general object, the enlargement of the industry, might very properly and usefully be established. Sir Francis quoted recent figures of a bacon factory which showed that, in spite of all their efforts, only 40 per cent. of the pig supplies coming forward fulfilled their requirements: 16 per cent. were what the factories called sixes—that is, pigs weighing less than seven score dead weight, which was too small—the remaining 44 per cent. being too fat for the bacon trade. He considered that the Breed Societies might help by encouraging the production of the kind of pig which the markets required. He would call it the B.S. Pig—best selling pig. He regretted that the Ministry's Report had not gone into this question of increasing supplies, but believed that there was at the Ministry a quantity of material on the subject and he hoped that the Pig Industry Committee would be appointed and set actively at work, when they might make use of this material. He recommended the Report to all pig producers. The Report, subject to the substitution of the word "mild" for "fully cured" in the penultimate paragraph, was adopted.

Marketing of Poultry Report.—Mr. A. W. ASHBY, on behalf of the Standing Committee, moved the adoption of their Report recommending the Ministry's Report (No. 11, Economic Series), which advocated the well-planned co-operation of producers as one of the principal ways of raising the level of efficiency in the production and marketing of poultry. Education in the best methods of dealing with

poultry, from breeding to selling, was stated to be the industry's chief need. It was necessary, also, to bring the value of poultry as a food more favourably before the consumer. At present the consumer did not fully realize it, and that was no doubt in part due to the uninviting appearance of some of the dressed poultry displayed in retail shops. Some of the best table poultry in the world was being produced in this country, but a large quantity was being grown and marketed in a very unsatisfactory manner, hatched at the wrong time of the year, badly fed, marketed too old and in indifferent condition.

Mr. Ashby pointed out that the wholesale trade in fat poultry amounted to about ten millions sterling per annum, and the British producer supplied about three-quarters of the country's consumption. This consumption was, however, at present a small one as compared with other countries—about 1 per head of the population as against 3 or 3½ in the United States, and/or 7½ in Canada. The Report dealt fully with the technical processes of fattening and killing, plucking, shaping, packing and so forth, and he thought that members of the Council, or their wives and daughters, should read this technical part of the Report. He did not think that the Report dealt sufficiently with marketing. The poultry fattener and other producers had their problems and were willing to discuss them, but the poulterers in the cities, who had their profits, were not so willing to discuss them, and the Report was, consequently, failing in this aspect. He made three suggestions for the Council's consideration. First, that in no county should there any longer be a combined poultry and dairy instructor or instructress; the two industries should be separate and a special poultry instructor appointed. Second, that County Poultry Instructors should be brought together to discuss the Report, and to make or receive suggestions as to practical work in the development of the industry. Third, that the Ministry's Marketing Branch should organize regional conferences of farmers, through the National Farmers' Union and Poultry Organizations, to speed up improvements. The Report was adopted.

"Research and the Land."—Sir FRANCIS ACLAND moved the adoption of the Standing Committee's Report on the book under this title written by Mr. V. E. Wilkins, of the Ministry of Agriculture, at the direction of his Department. He said it gave an account of the progress already made in the country

in the various official researches in matters of agricultural science, and that, in the Committee's view, the book was of very considerable value to farmers, as it gave them up-to-date information on many questions of rural importance which they met daily in the course of their business, but as to which hitherto they had been without authoritative information. Sir Francis gave examples of the kind of information given in the work and heartily recommended it to all practical agriculturists. The Report was adopted.

Empire Marketing Board.—Mr. A. W. ASHBY, in place of Mr. George Dallas, moved that :—

> In view of the avowed policy of the Empire Marketing Board to place British produce first, Colonial produce second, and foreign produce third, the Council of Agriculture for England are of opinion that the Board should advertise British agricultural produce as well as Colonial agricultural produce in the Press and on hoardings in this country, and, further, that British produce, both agricultural, such as pedigree live stock, and non-agricultural, should be advertised in the Press and on hoardings throughout the Colonies and Dominions in all cases in which Imperial trading ought to be encouraged.

He referred to the reports as to the researches which had been set on foot as a result of the Empire Marketing Board's activities, but he said that the Council knew comparatively little at present of what the Board was doing or thinking. Lord Bledisloe had told the Council that £500,000 was available this financial year for the purpose of the Board's work. In regard to pedigree live stock, advertising in the Dominions and Colonies was hardly enough; veterinary restrictions on import should be removed wherever possible. Isolation or quarantine might be arranged in this country in cases where that was necessary for the protection of the health of Dominion cattle. With regard to publicity for our non-agricultural products in the Dominions, he pointed out that the great flood of produce coming into this country from the Dominions and foreign countries could only be taken up when the purchasing power of the working classes was much higher than at present. This purchasing power was dependent on the power of manufacturers to sell their goods in other countries, and the two things could not be separated.

The MINISTER said that he did not think that the Council, when they had heard what was being done, would consider that the Empire Marketing Board was unmindful of the claims of British agriculture or that they were interpreting their reference in a narrow sense.

Mr. TALLENTS, the Secretary to the Empire Marketing Board, said that he would not follow Mr. Ashby into the questions of research and marketing investigations which the Board were conducting, as these were not dealt with in the resolution. There was no contest at all as to the policy of the Board in its intentions and resolve to place British produce first, Colonial produce second, and foreign produce third. The advertisements which had been appearing in the last few months certainly laid more stress on overseas produce than on home produce. That arose because the Press followed such advertisement more closely on account of the Imperial Conference which had recently completed its sittings. This week, the first advertisement solely in favour of home produce had been published; others were on stocks. It took some time to prepare and bring out these advertisements, which included special posters in colour. A limited number of posters would be sent for special exhibition overseas, though the work of the Board was limited to the furtherance of marketing of Empire products in this country. It must be remembered that the grant was made in lieu of the carrying out of certain preference promises to the Dominions which were found afterwards to be impossible owing to election pledges, and the grant was originally to be applied only in respect of Dominion products. It was later decided that home products should be included, and should take the place of honour in the general campaign for the recommendation of Empire products on our markets. There was, however, no power to use the grant for home products destined to be sold in Dominion markets. An exception had been made in the case of pedigree stock, where it was considered that the results of the exportation of it from this country would be likely to be returned later in the form of both live stock and meat. The Board would be glad to consider any suggestions which members of the Council might like to make in regard to the furtherance of its objects.

Mr. CLEMENT SMITH asked whether agricultural seeds exported to the Dominions could be given the same consideration as pedigree live stock. Sir DOUGLAS NEWTON proposed that all the words after "in this country," in the resolution, should be omitted; the Board's activities ought to be concentrated on the home market and the fullest measure of publicity for our own produce on our market obtained. Sir ARTHUR HAZELRIGG seconded the amendment, which was spoken to by Sir FRANCIS ACLAND, Mr. DENTON

WOODHEAD, the MINISTER, Mr. R. G. PATTERSON (Staffs), Mr. BRUFORD (Somerset), put to the meeting, and carried. The original resolution as amended was then put to the meeting as a substantive motion and carried.

Milk and Dairies Order, 1926.—Major FAWKES (Yorks W.R.) moved the adoption of the Standing Committee's Report on the Milk and Dairies Order, 1926, which is as follows :—

(1) The Standing Committee has had under consideration the Milk and Dairies Order of 1926, which came into force on October 1 last, though parts were reserved for operation at future and distant dates. The Committee hears from all quarters that milk producers regard the Order as a genuine and not unreasonable endeavour to secure an improvement of the hygienic standard of milk production; they are anxious to comply with the Order, but are nevertheless apprehensive of the way in which some Local Authorities may administer it, and indeed are already doing so.

(2) The Committee recognizes that, in applying general regulations to so large and varied an industry as that of milk production, regard must be had to local circumstances and methods, and that some discretion must be given to the officers whose duty it is to administer them. Those officers should, however, possess a real knowledge of the facts that count in clean milk production so as to be able to exercise that discretion rightly. When they become so equipped, producers generally will feel that they have nothing to fear. At present the administrator is often the local Sanitary Officer, who has various duties, but may have had little or no opportunity of studying the proper requirements of clean milk production. He may easily demand of the producer structural alterations and other conditions which are unfair and unreasonable and perhaps of little or no service to the purpose in view.

(3) The Committee, therefore, feels that the manner in which the Order is administered is a matter of the utmost importance at the present time, and it desires to emphasize its view that it is the methods and personnel rather than the premises and equipment which tell in the business of producing clean milk.

(4) While the Committee recognizes, however, that personnel and methods of handling cows and cleaning premises are of primary importance, it recognizes also that the expense of maintaining the cleanliness of cows is largely dependent on the character and quality of the buildings and equipment. It therefore wishes to direct the attention of landowners and farmers to the importance of buildings in securing clean milk at a reasonable cost.

(5) In the Committee's view it is specially desirable that there should be the closest co-operation between those who are trying to help the producer and those who are administering the regulations. It is satisfactory that the Ministry of Agriculture should have foreseen this need in providing short courses for Sanitary Inspectors at the various centres of provincial agricultural education. These courses are usually of five days' duration, held either on consecutive days or on one or two days per week over a period of weeks; they cover instruction in the methods of equipment, which is given in the most practical form possible and demonstrated in practice wherever feasible. In some cases decentralized courses have been held, and there is a tendency for the number of these to be increased. The Committee is informed, however, that while

the Sanitary Inspectors' Association is greatly interested in the matter and has been of immense service in encouraging its members to attend, there is still apathy and backwardness on the part of certain local Health Authorities in encouraging their officers to do the same.

(6) The Committee considers also that attendance at such classes is desirable from another point of view, namely, to provide uniformity in the interpretation of the Order by all local authorities. If there is a marked difference in this respect, feelings of injustice and resentment will no doubt arise amongst milk producers in some of the areas.

(7) Furthermore, there is at present keenness among many producers to improve the general standard of cleanliness in milk production. This must be gratifying to the organizers of Clean Milk Competitions and demonstrations, and to the technical advisers of the Agricultural Colleges, County Agricultural Education Authorities, and Agricultural Societies, to whose work it is very largely due. It should be taken every advantage of and in no way discouraged.

(8) In all the circumstances, the Committee considers it desirable, besides encouraging the attendance of all local officers concerned at the classes above referred to, that County Councils should in all cases give a definite lead to the local authorities in their administrative area as to the right policy to pursue. This might be done by sending them printed suggestions or by arranging for them to meet the Councils' representatives and discuss with them the best ways and means of carrying out the Order. The Committee considers that it would assist in this object and be likely to secure greater uniformity if the Ministries of Health and Agriculture would issue a memorandum of general suggestions under this head.

SALE OF FOOD AND DRUGS ACTS

(9) It has also been represented to the Committee that certain local authorities have appointed the police as sampling officers in the administration of the Sale of Food and Drugs Acts. These officers have sometimes to go to farms in order to take samples, or to waylay the delivery of the producer's milk for that purpose. The attendance of the police in such circumstances is resented by many producers, mainly because of the possibility of conveying the impression to neighbours that an offence has already been committed. The Committee has some sympathy with this attitude of mind, and urges that in all cases the sampling officers should be the Sanitary Inspectors and not the police.

Major FAWKES pointed out that success in the administration of the Order centred on the individual whose duty it was to carry out the Order. Clean milk produced in summer time and not allowed to get above 60° F. would keep two days, whilst clean milk produced in winter and properly kept would keep as long as five or six days; that sort of question was entirely in the hands of the producer. He knew of a case where an individual farmer had model buildings but whose milk was not good because an old employee, whose duty it was to look after the utensils, would take them from

the sterilizer and very carefully and methodically wipe them with an old duster which he kept hanging up outside for the purpose. Major Fawkes concluded with some interesting and suggestive observations on the subject of "Sufficient Light," and dealt with the groundlessness of the fear that producers' premises could be closed at once under the Order and the need for discussions between administrators in each county. He instanced what was being done in the West Riding of Yorkshire.

Mr. GIBBONS asked whether the fee of £5 which had to be paid by the producer of certified milk could be reduced. Mr. CHARLES ROBERTS supported a recommendation to that effect and raised the point of the small producer who kept a cow or two for himself, and incidentally supplied milk to casual customers or to summer visitors. There should be uniformity in the view that Benches would take as to whether this man should or should not come under the Order. He suggested that something might be done to assist small owner-occupiers to make the necessary structural alterations, through the system of agricultural credit which he understood the Government to be considering. In default of a general scheme, the money might be obtained from the Public Works Loans Commissioners. Such loans would be attended with very little risk and the object would be in the interests of public health. Mr. PATTERSON emphasized the desirability of the small producer being excluded from the Order. Major HOTCHKIN, Mr. HAMILTON, Mr. BRUFORD, and the MINISTER also joined in the discussion. The Minister said that the Ministry of Health were, he understood, dealing with the question of the inclusion of the small man, and other points on which official advice and observations on the Order appeared necessary at this stage. He had brought the Report of the Standing Committee to the notice of the Minister of Health and of the Agricultural Committee of the House of Commons, when it was in draft, and he gathered that Mr. Neville Chamberlain had been very much interested to hear of the courses which were being provided to show sanitary inspectors what could be done in the way of producing clean milk under the least extravagant conditions. As regards the £5 fee, it did not arise under the Order, but he could say that he was fully aware of the hardship that was felt and had discussed the matter with the Ministry of Health.

The Report was adopted.

Home-Produced Meat for Army, Navy and Air Force.—Mr. H. W. THOMAS moved the following resolution :—

> That in view of the low prices prevailing for certain kinds of beef and mutton His Majesty's Government be requested to consider the desirability of providing the members of the Army, Navy and Air Force with home-produced meat instead of imported.

Mr. LOVELL seconded the resolution and the Minister and Sir FRANCIS ACLAND spoke upon it.

Mr. THOMAS said that the principal reason for his bringing the matter forward was the very low price at present being paid for certain kinds of beef and mutton. Some years ago H.M. Forces were fed entirely on home-produced beef and, for some time prior to the war, they were almost entirely so fed. If arable farming was to be retained, it was necessary that stock should be kept, in order to provide manure. Sugar beet, if it were widely taken up, also needed farm-yard manure. The keeping of stock should, therefore, be encouraged and he thought that this proposal was a practical way of doing it. The MINISTER said that everyone would sympathize with the object of the resolution ; whether it was adopted or not. It was, however, a matter of cost. If the Service Departments bought only home-grown meat it would about double their outlay. The Ministry had done what it could to represent the farmer's case and the Army were buying their hay, oats, and potatoes in this country ; with meat and bread there were obvious difficulties. The motion was put to the meeting and carried.

Re-election of Standing Committee.—The annual election of the members of the Standing Committee came up for consideration, and the existing Standing Committee was unanimously re-elected.

Report from Agricultural Advisory Committee.—The Report (No. 16) of the Proceedings of the Agricultural Advisory Committee for England and Wales, which follows, was received by the Council.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES

REPORT (NO. 16) TO THE COUNCILS OF AGRICULTURE FOR ENGLAND AND WALES ON THE PROCEEDINGS OF THE AGRICULTURAL ADVISORY COMMITTEE.

One meeting only of the Committee has been held since the date of the last Report to the Councils (October 15, 1926), namely, that on December 8, 1926. The Minister

was in the chair on that occasion and the following items were dealt with :—

(1) **Foot-and-Mouth Disease.**—The Deputy Chief Veterinary Officer (Mr. Kelland) gave a short résumé of the position in regard to the disease. It was reported that the Wiltshire outbreak had been caused by a dead calf being fed to pigs. The calf showed no lesions of foot-and-mouth disease, but nevertheless communicated it. It was recommended that a warning should be issued to reach if possible those who would be likely to feed dead carcasses to pigs, and their attention called to the possibility of transmitting, not only foot-and-mouth disease, but the more deadly disease of anthrax, by this means.

(2) **Colonial Restrictions on the Importation of British Pedigree Stock.**—This question was discussed, and the Committee was informed that it was hoped to relax both the South African and Australian restrictions in the near future.

(3) **Disinfection of Road Vehicles after Carrying Animals.**—This question was raised in view of the fact that railway companies were required to disinfect their trucks and road vehicles were not obliged to be similarly dealt with. This created an unfair position as between rail and road. The Committee was informed that an Order was now to be issued which required the disinfection of road vehicles used in carrying animals, except those vehicles owned by a farmer and used for carrying his own stock.

(4) **Report on Warble Fly Pest.**—The Committee received the Report of the Departmental Committee on the Warble Fly Pest.

(5) **Proceedings of Various Advisory and Departmental Committees.**—The Committee received a Report of the proceedings of the various advisory and departmental committees for a period of five months ending November 11, 1926.

(6) **Milk and Dairies Order, 1926.**—The Minister informed the Committee that he had discussed the working of this Order with the Agricultural Committee of the House of Commons and that he understood that a Report on the matter would be laid before the next meeting of the Council of Agriculture by its Standing Committee.

MARCH ON THE FARM

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organizer for Derbyshire.

Seasonal Operations.—In the live stock departments of the farm, March is a winter month; cattle and sheep are dependent on rack and trough foods, and little assistance is as yet obtainable from new growth of herbage. Indeed, the demand on the stacks and root clamps is generally heavier in March than in the preceding months. As regards arable land operations, however, this month is looked upon as the opening of spring. Ordinarily it is a time when both men and horses have to work at full-pressure and, with the appreciable lengthening of the duration of daylight and sunshine which characterizes March, the output per head increases.

Although conditions in November interfered with the sowing of winter corn and the manuring of meadows and land intended for fallow crops, subsequent periods of comparatively dry weather and occasional frosts have in considerable measure permitted the overtaking of arrears; and heavy land is expected to work down rather better than usual, especially where the chance was taken to cross-plough or plough back about the beginning of February.

Priority is usually given to the sowing of spring corn. Where there is no reason to fear that the crop may be infested with annual weeds, such as charlock and spurrey, the seed corn should be put into the ground as early as the soil and weather conditions will allow; but where weed control is necessary, the first operation should be a good chain harrowing as soon as the soil is dry enough to carry the team without injury to its texture. The object here is to create a mulch which, by checking evaporation, will hasten the warming of the soil to the temperature at which the weed seeds in the surface layer of the soil will germinate. Sowing is deferred for about fourteen days, at the end of which time, unless cold weather intervenes, the weed seedlings will have begun to appear and may be destroyed. Land that is not so free from "twitch" (*Agrostis*) as it might be, should be liberally treated with nitrogenous, or perhaps complete, fertilizer. It is a fortunate circumstance that oats are more responsive than is twitch to nitrogen, and by taking advantage of this characteristic the crop may be assisted to suppress the weed.

Land that has been sown with corn must usually be rolled to leave a surface free from clods and stones that might

interfere with the reaper. Under certain conditions rolling immediately after sowing may be good practice, as on light, dry soils; and where the crop preceding the corn was lea ploughed down late, the roller may have a beneficial effect. Ordinarily, however, it is better not to roll until after the crop has germinated and the soil is dry to the depth of at least one inch. On strong land, the effect of rolling too soon after drilling is to dispose the soil to become crusted, and sometimes the horse's hoof-marks persist visibly as sterile patches, bare of plants. Caution in the use of the roller is advisable also when giving early spring attention to winter-sown corn. As a rule, the primary cultural need of the wheat and winter oat crop in March is harrowing to loosen and aerate the beaten-down surface. The importance of a top dressing of quick-acting nitrogenous fertilizer, just about the time when the wheat plant begins to revive, needs only to be mentioned here.

March is a suitable time for the sowing of cereal and legume mixtures for mowing, green soiling, or ensilage. Land not quite clean enough for ordinary corn crops may sometimes be conveniently dealt with in this way; the mixture prevents the weeds from spreading seriously and the early cutting allows of a half-fallow later in the season. For hay, a suitable prescription is six stones of special forage oats and six stones of field peas, the latter being more readily made into hay than are vetches. For green feeding or ensilage, however, part of the peas may be replaced with vetches; and beans are a useful addition; but preferably, the beans should be ploughed in shallow, a fortnight before the other seeds are drilled.

Excepting on light land in comparatively dry districts, where early and second early potatoes are planted, little attention can as yet be given to the fields intended for crops of the roots group. It is advantageous, however, to stir the surface with the chain harrows as soon as the condition of the soil will permit. The effect of this has been partly explained in the third paragraph above, but a further effect, here specially desired, is to prevent the formation of intractable clods.

March is late for boxing seed potatoes, but even late boxing is better than leaving the tubers to waste their first sprout in the pits. Boxing also gives the grower a little more time in which to prepare the ground; and, as is well known, potatoes, in contrast with beet and mangolds, thrive best on land that has been well opened up and aerated in the spring. In January, 1924, I stated that, apart from preserving the first sprout, the

wilting of the sets in the boxes was advantageous. This statement was based on the observation that wilted sets usually give a vigorous plant. McLean, of Bangor, however, has found that only healthy tubers wilt and become flabby on sprouting, and that seed infected with leaf roll retains its hard condition. Boxing may thus be a means of detecting and separating infected tubers.

Certain readers, impressed with the milk-producing virtues of plants of the cabbage class, have inquired regarding the existence of varieties capable of keeping fresh for feeding after December and mid-January, when ordinary ox-cabbages begin to decay and marrow-stem kale becomes woody. Thousand-headed kale is well known to be very hardy, and if drilled in May will answer the purpose here intended. There are, however, hardy types of cabbage which, if sown in March and transplanted in June, are perhaps better than kale, especially in winters when snow breaks down the latter crop badly. Purple drumheads may be specially mentioned; and, as is well known, Savoy cabbages keep fresh until the end of the winter. Savoys, however, do not ordinarily yield a heavy weight per acre, and have not a good reputation as cattle food. Of the conical-hearted types, Winningstadt is hardy and keeps well, but should perhaps be sown a little later than March. The disadvantages of depending upon crops left out in the fields all winter, however, are obvious, and the use of land for such crops complicates the rotation.

Seeds Mixtures.—As has been mentioned in previous issues of these notes, there are two types of seeds mixture for one year's lea. The one, consisting chiefly of Italian rye-grass and early-flowering red clover, excels in providing early spring feed for ewes and lambs, and in yielding aftermath or second crop. Where excess of Italian rye-grass is sown, however, the clovers may be seriously repressed and both the yield and botanical composition of the hay are adversely affected. The Cockle Park type of mixture, in which the principal components are perennial rye-grass and late-flowering red clover, has been found to be an excellent prescription for a single cut of hay. It is, of course, rather late in reaching maturity and goes down badly if much rain falls just before mowing, but as a rule little difficulty is encountered in cutting it.

During the past year, experiments comparing the yields of hay obtainable from the above two types of mixture were carried out at the Midland Agricultural College and at a centre near Chesterfield. At the college the trials were carried

to the further stage of comparing the analyses of the hay produced. The yields of hay in each of the two experiments were as follows :—

College (Light loam)	Plot 1 lb.	Plot 2 lb.	Plot 3 lb.
Perennial rye-grass	18		
Italian rye-grass .. .		18	12
Late-flowering red clover	5	5	—
Early-flowering red clover	—	—	8
Alsike	1	1	—
Trefoil	½	½	—
Yield of hay : cwt. per acre	73·6	73·0	64·5

Chesterfield (Heavy loam)	Plot 1	Plot 2	Plot 3	Plot 4
Perennial rye-grass ..	—	18	9	—
Italian rye-grass	12	—	6	12
Late-flowering red clover	—	5	2½	—
Early-flowering red clover	5	—	2½	5
Alsike	2	2	2	2
Trefoil	1	1	1	1
Yield of hay, cwt. per acre	69·8	54·8	62·4	67·7

In the Chesterfield experiment, the Cockle Park mixture proved to be inferior to the standard Italian rye-grass and broad red combination.

Permanent Grass Land.—There is already so much under-stocked and under-manured grass land in the country that it is a matter for regret that the process of seeding-down continues. Much of the permanent grass land in the country could be made to maintain about double its present head of stock, but the farmer either has not the requisite capital to treat and stock the land for higher production, or he is of the opinion that under present conditions extensive methods are more expedient.

Improvement by manuring can sometimes be accelerated by severe laceration of the turf, and in recent years implements have been designed specially for such work. An experiment carried out last spring at the Midland College farm, however, may be mentioned both as an example of the benefit obtained from turf-tillage and on account of the means employed in executing the work. A peg-tooth harrow suitably weighted was use to tear out the rough herbage, which was collected and removed, and the disc harrow, also weighted and set to cut three inches deep, was used to penetrate the sward. The operation was carried out in both directions of the field so as to cut the turf into small squares. The field when finished presented a very rough appearance, but in the spring the benefit was seen to be greater than that obtained from heavier manuring on plots not scored in the above manner.

NOTES ON MANURES FOR MARCH

H. V. GARNER, M.A.,
Rothamsted Experimental Station.

Synthetic Nitrogenous Manures.—Until recent times the chief supplies of combined nitrogen purchased by farmers were by-product sulphate of ammonia and Chile nitrate of soda. These were supplemented in the early years of the present century by fertilizers obtained by the fixation of atmospheric nitrogen in the form of Norwegian nitrate of lime (1903) and calcium cyanamide (1905). The war gave a great impetus to the fixation industry, especially in Germany, where, on the cessation of supplies of Chile nitrate, the by-product industry was quite inadequate to meet the agricultural demand, and large quantities of nitrates were required for the manufacture of explosives. This need was met by the chemical trade, with the result that in Germany, and to an increasing extent elsewhere, a large number of little-known synthetic nitrogen compounds are now on the market to be used for agricultural purposes.

As far as this country is concerned the chief substances of this class which are available in quantity are as follows :—

Sulphate of Ammonia.—In addition to the well-known by-product from gasworks and coke ovens there is a considerable quantity of home-produced synthetic sulphate of ammonia on the market. In this case the supply has been increased, but the products are essentially the same.

Cyanamide.—This material has recently been re-introduced, and although not yet widely used here, occupies a recognized place in the fertilizer industry on the Continent and in the United States. It contains about 19 per cent. of nitrogen, which is at present offered at a cheaper rate per unit than any of the other forms of combined nitrogen. On account of its rather slow action it is more suited for application before drilling than for top-dressing purposes. It leaves an appreciable residue of chalk in the soil.

Nitrate of Lime.—The Norwegian supplies have been used here for some years and have an agricultural reputation similar to that of nitrate of soda ; but care must be taken to choose drying weather for the application, as the material picks up moisture from the air very readily and becomes sticky. The content of nitrogen is about 13½ per cent. Recently another nitrate of lime of synthetic origin has appeared in this country

in the form of a white crystalline substance containing 15½ per cent. of nitrogen.

A number of other synthetic products are finding their way into agriculture on the Continent, and some of them have been investigated experimentally in England. These experiments are still in progress. The most important of these substances are :—

Ammonium Chloride.—This is a white crystalline compound containing 25 per cent. of nitrogen. Its action is broadly similar to that of ammonium sulphate and it presents the same range of agricultural uses. Experiments are still in progress at Rothamsted and elsewhere to compare its effects with those of the sulphate in greater detail.

Urea.—This substance contains no less than 46 per cent. of nitrogen, and is therefore more than twice as concentrated as sulphate of ammonia. Urea is the valuable constituent of the urine of farm stock, and in this form its fertilizing value is well known to farmers. As manufactured it is a white crystalline solid. Its concentrated nature renders it suitable for long transport. On the other hand, if applied alone in dressings providing the customary amounts of nitrogen for farm purposes, it may be difficult to distribute the requisite small quantity sufficiently evenly. In contrast to ammonium sulphate or chloride it leaves no residue of strong acid in the soil in the course of its transformations. Trials are still in progress with this substance, which appears to have much the same action as sulphate of ammonia as far as its nitrogen is concerned.

In Germany synthetic products have developed in greater variety. Two tendencies are noticeable. An attempt is being made to replace some of the ammonia nitrogen in the newer fertilizers by nitrate nitrogen. This is to avoid, in part, the well-known decalcifying effects of ammonium salts of strong acids, which can produce a condition of soil acidity, as has been shown in the classical experiments on grass at Rothamsted, and on barley at Woburn. Hence we find products, such as Leuna Salpeter, in which approximately one-third of the total nitrogen is in the form of nitrate, the remainder being present as ammonia. Synthetic nitrates of soda and of lime are also made, while ammonium nitrate, though not suitable for use in a pure state, is employed as a constituent of more complex fertilizers. The second tendency is seen in the production of mixed or compound fertilizers containing high-grade quick-

acting ingredients whose nature is disclosed. The nitrogen is synthetic and may consist partly of nitrates and partly of ammonium compounds; the phosphate may be present as an ammonium salt, thus avoiding the presence of the gypsum which is usually associated with water-soluble phosphate; while the potash is supplied as high-grade salts. As an example of such a complete fertilizer the recently introduced Nitrophoska will serve. It is guaranteed to contain

17 per cent. nitrogen, one-third as nitrate, the remainder as ammonia.
25·5 per cent. soluble phosphate.
21·1 per cent. potash.

Another grade is manufactured containing slightly more potash to meet the requirements of potash-loving crops on light soils.

Spring Corn.—Experiments carried out at a number of centres since 1922 under the research scheme of the Institute of Brewing indicate that a moderate dressing of sulphate of ammonia may be included in the fertilizer mixture given to barley, without injury to malting quality and with benefit to yield, provided that the crop is not lodged. Used in this way 1 cwt. of sulphate of ammonia per acre is permissible and has usually increased the crop by about 5 bushels of dressed grain. The action of the nitrogen has, on the whole, been more certain and more remunerative than that of any other fertilizing constituent. A heavier dressing than 1 cwt. is of course inadvisable, and when 2 cwt. of sulphate of ammonia per acre were used in a complete mixture at Rothamsted the quality of the grain was definitely lowered, although in this case the crop was not lodged. Where there is reason to believe that the land intended for barley is in need of phosphate and potash, a suitable mixture would be 2 cwt. superphosphate, 1 cwt. muriate of potash, and 1 cwt. sulphate of ammonia per acre. If, on the other hand, a good supply of phosphate and potash has been applied to other crops in the rotation, the question arises whether these constituents should be omitted and reliance placed on nitrogen alone. There is little doubt that as far as yield is concerned 1 cwt. sulphate of ammonia per acre could be successfully applied in such cases; the effect of the nitrogen, used alone on the malting quality of the grain, is being investigated at present.

In manuring oats the quality factor is not so important, and we may try to obtain as heavy a crop as will stand. Whether phosphate or potash, or both, are required will be decided

with reference to the treatment of the previous crop and the nature of the soil. Where oats follow a good seeds ley, manuring is seldom necessary and nitrogenous manures will rarely be used. Oats, following a previous straw crop, will usually respond to a nitrogenous dressing, and, in cases of doubt, care should be taken not to limit the effect of the nitrogen by lack of a suitable addition of the other constituents. It occasionally happens that, owing to bad drilling conditions in autumn, a little of the wheat land may be left over to be sown in the spring. The choice of a suitable variety for spring sowing is the chief element of success, but in view of the shorter growing period the plant can be helped along by a light dressing of artificials applied before drilling. Assuming that wheat land can provide its own potash, 2 cwt. of superphosphate, and, on soils in only medium condition, 1 cwt. of nitrate of soda or sulphate of ammonia, should do much to assure a good start.

Early Potatoes.—In most of the specialized districts where early potatoes are grown, organic manuring is the usual basis of the treatment. For a crop which must as far as possible be kept going without a check, the water-holding capacity and mellowness imparted to the soil by the organic matter is of the greatest value. Farmyard manure, town stable manure, or in coastal regions seaweed, are used in large dressings, twenty tons or more per acre being quite a usual application. Since an abundant supply of readily available plant food is also required, the general practice is to give from 8 to 12 cwt. per acre of a complete mixture of artificials in addition to the organic manuring. Formulas vary from district to district, and have usually been developed by local experience. A typical mixture would contain about 5½ per cent. of nitrogen, 18 per cent. soluble phosphate, and 5½ per cent. of potash, the main ingredients usually being in the form of sulphate of ammonia, superphosphate, and either sulphate or muriate of potash. The percentage of potash is rather low, but should be considered in relation to the large quantities of dung and seaweed which are used. Experimental work recently conducted at Kirton,* in Lincolnshire, under conditions where dung is rarely available, have shown that in these circumstances nitrogen and potash are more important than phosphate, and a mixture consisting of 2½ cwt. of sulphate of ammonia, 2 to 4 cwt. superphosphate and 1½ cwt. of muriate of potash

* J. C. Wallace, this JOURNAL, XXXII, No. 10, January, 1926.

is satisfactory. Assuming the higher level of phosphate—although in the trials the lower figure was sufficient—this mixture would analyze 6½ per cent. of nitrogen, 17 per cent. of soluble phosphate and 9½ per cent. of potash. Given good cultivation, it is suggested that such a mixture could be used up to about 12 cwt. per acre.

PRICES OF ARTIFICIAL MANURES

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

Description	Average price per ton during week ending February 9.				
	Bristol	Hull	L'pool	London	Cost per unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of soda (N. 15½%) ..	..	13 15	13 5	13 10	17 5
„ „ lime (N. 13%) ..	..	..	..	11 10*	17 8
Sulphate of ammonia :—					
Neutral (N. 20·6%)	12 3*	12 3*	12 3*	12 3*	11 10
Calcium cyanamide (N. 19%) ..	9 14*	9 14*	9 14*	9 14*	10 3
Kainit (Pot. 14%)	3 2	2 17	2 17	2 15	3 11
Potash salts (Pot. 30%)	4 17	..	..	4 10	3 0
„ (Pot. 20%)	3 12	3 2	3 9	3 2	3 1
Muriate of potash (Pot. 50-53½%)	9 10	8 5	8 13	9 7	3 6
Sulphate „ (Pot. 48-51½%)	11 10	10 5	10 16	11 5	4 5
Basic slag (T.P. 30%)	..	3 2§	3 3§	..	..
„ (T.P. 28%)	..	2 11§	2 19§	..	..
„ (T.P. 26%)	..	2 7§	2 15§	..	..
„ (T.P. 24%)	..	2 2§	..	..	..
Ground rock phosphate (T.P.58%)					
Very fine grade ‡	2 15	..	..	2 15*d*	0 11
Fine Grade ‖	2 10	..	..	2 15*d*	0 11
Superphosphate (S.P. 35%) ..	3 8	..	3 9	3 10	2 0
„ (S.P. 33%) ..	..	..	3 6	..	..
„ (S.P. 30%) ..	3 2	2 15	3 2	3 3	2 1
Bone meal (N. 3¾%, T.P. 45%) ..	8 15	8 5	8 10	8 0	..
Steamed bone flour (N. ¾%, T.P. 60-65%)	6 0†	6 10†	6 5	5 15	..
Burnt lump lime	2 0	1 12*a*	2 0*b*	2 1*c*	..
Ground lime	2 7	2 1*a*	2 9*b*	1 15*c*	..
Ground limestone	..	..	1 10*b*	..	..
Ground chalk	..	1 9	..	1 5*c*	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire. London prices are for 4-ton lots delivered in the home counties.

‡ Fineness 80% through standard screen of 14,400 holes to the square inch (120 mesh sieve).

‖ Fineness 80% through standard screen of 10,000 holes to the square inch (100 mesh sieve)

a Delivered to Hull

b Delivered to Liverpool area.

c Delivered in 4-ton lots to London.

d Price for 4-ton lots f.o.r. at Northern London Stations. At G.W.R. and S.R. London Stations the cost to purchasers is 2s. 6d. per ton extra.

NOTES ON FEEDING STUFFS FOR MARCH

E. T. HALNAN, M.A.,
School of Agriculture, Cambridge.

The Feeding of Goats for Milk Production.—The keeping of goats for milk production has shown considerable progress during the last decade, and the extent to which goats are now kept for this purpose is evidenced by the number of entries and exhibits made at the principal agricultural shows, and by the fact that several milk-recording societies for goats are now in existence and are affiliated to the Central Council of Milk-Recording Societies. The reason for the popularity of the goat as a milk-producing animal is not far to seek. The goat is a hardy animal, thrives well under poor conditions, and does not require expensive or extensive accommodation. For these reasons the goat is an ideal milk-producing animal for the small-holder and the cottager, particularly as the bulk of its food can be supplied by roadside grazing. Moreover, considerable attention abroad has been paid to the production of deep-milking strains of goats, and by importation from the Continent the native breed of goat in England has been improved to such an extent that the purchase of goats of good milking strain is a comparatively simple matter.

The increased attention paid to milch goats has led to a demand for information on the feeding of these animals, and the purpose of this article is to lay down a few simple rules for the guidance of goat keepers in the feeding of their animals. The feeding principles underlying milk production in the goat are similar to those governing milk production in the cow. As in the case of the cow, the ration of the goat may be divided into two parts, a maintenance portion and a production portion. The maintenance portion is required to maintain the functional activities of the goat and to keep it in a healthy, thriving condition. The production portion is required to yield the food elements needed for the milk produced. Readers of these articles will be aware of the fact that a perfect food needs to supply to the animal a certain amount of digestible protein, or flesh-forming material, and a certain amount of energy producers—fats, starches, sugar, and to a certain extent woody fibre, coming under this latter category. In addition, a certain proportion of mineral substances and vitamines are required, and, except in special circumstances, adequate amounts of these substances are generally present in typical food mixtures. For this reason a feeding system generally only expresses the

requirements of the animal in terms of digestible protein and energy, the energy required being expressed for reasons of simplicity in terms of starch, the digestible fats, sugars, fibre, and starches being comprised under, "starch equivalent."

In the case of the goat, the daily requirements for maintenance, expressed per 100 lb. live weight, are 0·11 lb. digestible protein and 0·85 lb. starch equivalent. For milk production, in addition to the maintenance requirements already given, the goat will require 0·15 lb. of digestible protein and 0·63 lb. of starch equivalent for every quart of milk produced per day. From these figures it becomes a comparatively simple matter to calculate the rations required for any goat according to the milk yielded. The daily maintenance requirements of a 100-lb. goat, as indicated above, would be satisfied with 3 lb. of good quality meadow hay per day. As the weight of the goat increased, so the maintenance requirements would also increase, but as the requirements of the animal are proportional to the surface and not to the body weight, the increase of food is not proportional to the weight. Thus the maintenance requirement of a 150-lb. goat would be 4 (not 4½) lb. of meadow hay as the weight would indicate.

With regard to the production ration, the daily ration must contain 0·15 lb. digestible protein and 0·63 lb. starch equivalent for every quart of milk produced, so that a goat giving three quarts of milk a day would require a daily production ration yielding 0·45 lb. digestible protein and 1·89 lb. starch equivalent. This would be satisfied by 3 lb. of a mixture consisting of crushed oats and beans in equal parts. A suitable ration for a 100-lb. goat giving three quarts of milk a day would therefore be: hay, 3 lb.; oats, 1½ lb.; beans, 1½ lb. A 150-lb. goat giving a similar amount of milk would require: hay, 4 lb.; oats, 1½ lb.; beans, 1½ lb., the extra pound of hay being required for extra maintenance necessitated by the fact that the animal is larger. In order to facilitate ease of calculation, a few suitable mixtures are given for milk production:—

FOR MILK PRODUCTION PER QUART OF MILK PER DIEM

Mixture by weight	Quantity per quart of milk
(1) 1 oats, 1 beans	1 lb.
(2) Bran	1¼ lb.
(3) Palm-kernel cake	1 lb.
(4) Coconut cake ..	1 lb.
(5) 1 linseed cake, 1 maize	1 lb.

FOR MAINTENANCE OF 100-LB. GOAT PER DIEM

Mixture by weight	Quantity per quart of milk
(1) Good meadow hay	3 lb.
(2) 2 oat straw, 1 clover hay ..	3 lb.
(3) 2 oat straw, 4 roots	6 lb.

The above rations approximately satisfy the standards given. In the summer, with ample access to pasture, little extra food will be required except in the case of the heavy milkers. In the winter the goat keeper will need to vary the bulkiness of the ration according to the animal's appetite, since in the case of the heavy milkers it will be sometimes a matter of difficulty to persuade the goat to consume its full ration if a large quantity of bulky food is included. In such cases, the ration must be altered by reducing the quantity of bulky food fed, supplementing the deficiency thereby caused by adding a food-equivalent amount of food of a concentrated nature.

Farm Values.—The prices in respect of the feeding stuffs used as bases of comparison for the purposes of this month's calculations, are as follows:—

	Starch equivalent	Protein equivalent	Per ton
	Per cent.	Per cent.	£ s.
Barley (Imported)	71	6·2	9 15
Maize	81	6·8	8 0
Decorticated ground nut cake	73	41·0	11 15
" cotton cake	71	34·0	10 0

(Add 10s. per ton, in each case, for carriage.)

The cost per unit starch equivalent works out at 2·33 shillings, and per unit protein equivalent, 1·59 shillings.

The table is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values" which it is recommended in the Report of the Committee on Rationing Dairy Cows should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows are given in the November, 1926, issue of the Ministry's JOURNAL.)

FARM VALUES.

CROPS	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	9 3
Oats	60	7·6	7 12
Barley	71	6·2	8 15
Potatoes	18	0·6	2 3
Swedes	7	0·7	0 17
Mangolds	7	0·4	0 17
Beans	66	20·0	9 6
Good meadow hay	31	4·6	3 19
Good oat straw	17	0·9	2 1
Good clover hay	32	7·0	4 6
Vetch and oat silage	13	1·6	1 13
Barley straw	19	0·7	2 5
Wheat straw	11	0·1	[illegible] 6
Bean straw	19	1·7	2 7

DESCRIPTION	Price per qr. s. d.	Price per qr. lb.	Price per ton £ s.	Manurial value per ton £ s.	Cost of food value per ton £ s.	Starch equiv. per 100 lb.	Price per unit starch equiv. s. d.	Price per lb. starch equiv. d.	Protein equiv. %
Wheat, British	—	—	12 0	0 14	11 6	72	3 2	1·70	9·6
Barley, British feeding ..	—	—	9 12	0 11	9 1	71	2 7	1·38	6·2
„ Canadian No. 3 Western	36 0	400	10 2‖	0 11	9 11	71	2 8	1·43	6·2
„ Argentine	35 9	„	9 16	0 11	9 5	71	2 7	1·38	6·2
„ Persian	33 0	„	9 5	0 11	8 14	71	2 5	1·29	6·2
„ Russian	35 6	„	9 19	0 11	9 8	71	2 8	1·43	6·2
Oats, English, white	—	—	9 7	0 12	8 15	60	2 11	1·56	7·6
„ „ black and grey	—	—	8 17	0 12	8 5	60	2 9	1·47	7·6
„ Scotch white	—	—	10 0	0 12	9 8	60	3 2	1·70	7·6
„ Irish black	—	—	8 15	0 12	8 3	60	2 9	1·47	7·6
„ Canadian feed	24 0	320	8 8*	0 12	7 16	60	2 7	1·38	7·6
„ American	22 6	„	7 17‖	0 12	7 5	60	2 5	1·29	7·6
„ Argentine	24 0	„	8 8	0 12	7 16	60	2 7	1·38	7·6
„ Chilian	22 0	„	7 14†	0 12	7 2	60	2 4	1·25	7·6
Maize, Argentine	34 3	480	8 0	0 11	7 9	81	1 10	0·98	6·8
„ South African	35 0	„	8 3*	0 11	7 12	81	1 11	1·03	6·8
Beans, English winter	—	—	10 13	1 10	9 3	66	2 9	1·47	20
Peas, English blue	—	—	17 0*	1 6	15 14	69	4 7	2·45	18
„ Japanese	—	—	29 0†	1 6	27 14	69	8 0	4·28	18
Dari, Bombay	—	—	12 5	0 14	11 11	74	3 1	1·65	7·2
Rye, homegrown	—	—	9 5	0 14	8 11	72	2 5	1·29	9·1
Millers' offals—									
Bran, British	—	—	7 10	1 5	6 5	42	3 0	1·61	10
„ broad	—	—	8 7	1 5	7 2	42	3 5	1·83	10
Middlings, fine, imported ..	—	—	9 12	1 0	8 12	69	2 6	1·34	12
„ coarse, British ..	—	—	7 12	1 0	6 12	58	2 3	1·20	11
Pollards, imported	—	—	7 0	1 5	5 15	60	1 11	1·03	11
Meal, barley	—	—	10 17	0 11	10 6	71	2 11	1·56	6·2
„ maize	—	—	9 12	0 11	9 1	81	2 3	1·20	6·8
„ „ germ	—	—	8 15	0 18	7 17	85	1 10	0·98	10
„ „ gluten feed ..	—	—	8 15	1 5	7 10	76	2 0	1·07	19
„ locust bean	—	—	9 5	0 9	8 16	71	2 5	1·29	3·6
„ bean	—	—	12 10	1 10	11 0	66	3 4	1·78	20
„ fish	—	—	22 0	3 18	18 2	53	6 10	3·66	48
Maize, cooked flaked	—	—	10 15	0 11	10 4	85	2 5	1·29	8·6
Linseed	—	—	18 0	1 9	16 11	119	2 9	1·47	19
„ cake, English, 12% oil	—	—	12 15	1 15	11 0	74	3 0	1·61	25
„ „ „ 10% „	—	—	12 7	1 15	10 12	74	2 10	1·52	25
„ „ „ 9% „	—	—	12 2	1 15	10 7	74	2 9	1·47	25
Soya bean „ 6% „	—	—	11 10*	2 9	9 1	69	2 7	1·38	36
Cottonseed cake, English, 5½% „	—	—	6 12	1 12	5 0	42	2 7	1·38	17
„ „ Egyptian, 5½% „	—	—	6 5	1 12	4 13	42	2 3	1·20	17
Decorticated cottonseed meal, 7% oil	—	—	9 7	2 9	6 18	74	1 10	0·98	35
Coconut cake, 6% oil	—	—	9 0	1 9	7 11	79	1 11	1·03	16
Ground-nut cake, 6% oil ..	—	—	8 2	1 13	6 9	57	2 3	1·20	27
Decorticated ground-nut cake, 7% oil	—	—	11 15*	2 11	9 4	73	2 6	1·34	41
Palm kernel cake, 6% oil ..	—	—	8 7	1 1	7 6	75	1 11	1·03	17
„ „ „ meal, 6% oil	—	—	10 0*	1 1	8 19	75	2 5	1·29	17
„ „ meal, 2% oil ..	—	—	8 0*	1 2	6 18	71	1 11	1·03	17
Feeding treacle	—	—	6 5	0 9	5 16	51	2 3	1·20	2·7
Brewers' grains, Dried ale ..	—	—	7 10	1 2	6 8	49	2 7	1·38	13
„ „ „ porter ..	—	—	7 0	1 2	5 18	49	2 5	1·29	13
„ „ Wet ale ..	—	—	1 5	0 8	0 17	15	1 2	0·62	4·8
„ „ „ porter ..	—	—	0 18	0 8	0 10	15	0 8	0·36	4·8
Malt culms	—	—	7 0†	1 12	5 8	43	2 6	1·34	16

Prices at London except where otherwise stated.

* At Hull. † At Liverpool. ‖ At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of January and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton, its manurial value is £1 1s. per ton. The food value per ton is therefore £8 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 5d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·29d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices: N, 11s. 8d. P_2O_5, 3s. 6d.; K_2O, 3s. 0d.

MISCELLANEOUS NOTES

Export of Breeding Stock

NUMBER and declared value of animals, living, for breeding, exported from Great Britain and Northern Ireland in the three months ended December, 1926, compared with the corresponding period in 1925. (From returns supplied by H.M. Customs and Excise.)

Country to which exported	Oct. to Dec., 1926		Oct. to Dec., 1925	
	Number	Declared value	Number	Declared value
CATTLE		£		£
Argentina	57	6,204	67	7,743
Bolivia	0	0	21	1,806
Brazil	30	3,692	0	0
Cuba	26	865	0	0
Guatemala	10	335	0	0
Uruguay	4	235	8	2,300
British India	8	390	5	470
Irish Free State ..	1,321	20,060	1,640	20,374
Palestine	4	1,500	0	0
Union of South Africa ..	0	0	58	4,465
Other countries	24	1,260	18	1,547
Total of cattle	1,484	34,541	1,817	39,705
SHEEP AND LAMBS				
Argentina	329	9,963	602	11,655
Bolivia	0	0	54	1,962
Brazil	40	1,210	0	0
Chile	7	1,200	24	1,185
Russia	266	3,803	0	0
Uruguay	85	2,268	159	3,490
Australia..	0	0	9	850
Falkland Islands ..	0	0	10	350
Irish Free State ..	1,112	2,346	850	3,991
Union of South Africa ..	0	0	29	693
Other countries	18	292	18	145
Total of sheep and lambs ..	1,857	21,082	1,755	24,321
SWINE				
Argentina	7	260	2	40
Bolivia	0	0	8	498
Chile	3	175	0	0
Germany..	5	115	12	475
Lithuania	24	1,200	0	0
Russia	0	0	50	1,000
Siam	5	350	0	0
Irish Free State ..	327	1,949	136	789
Other countries	20	450	22	543
Total of swine	391	4,499	230	3,345

Export of Breeding Stock in 1926

NUMBER and declared value of animals, living, for breeding, exported from Great Britain and Northern Ireland during 1926, with comparative figures for 1925. (From *Annual Statement of Trade* and returns supplied by H.M. Customs and Excise.)

Country to which exported	1926		1925	
	Number	Declared value	Number	Declared value
CATTLE		£		£
Argentina	337	51,329	509	108,562
Brazil	110	10,330	12	1,982
Chile	34	3,355	5	840
Germany	9	752	41	1,944
Uruguay	57	10,991	69	13,166
Australia	35	6,421	1	45
British India	14	740	23	1,120
Irish Free State	5,708	84,544	5,861	77,938
Kenya	18	1,204	30	1,842
Union of South Africa	20	1,150	141	12,914
Other countries	159	8,392	135	7,042
Total of cattle	6,501	179,208	6,827	227,395
SHEEP AND LAMBS				
Argentina	629	18,011	1,102	24,077
Bolivia	0	0	54	1,962
Brazil	49	1,452	3	100
Chile	14	1,403	27	1,420
Peru	0	0	90	1,156
Russia	266	3,803	205	3,454
Uruguay	166	5,079	204	4,660
Irish Free State	2,038	4,478	2,800	9,415
Union of South Africa	0	0	71	1,323
Other countries	99	1,764	139	3,968
Total of sheep and lambs	3,261	35,990	4,695	51,535
SWINE				
Argentina	23	627	13	247
Belgium	8	275	30	200
France	19	425	14	214
Germany	30	843	62	1,962
Italy	8	178	24	583
Russia	180	3,646	81	2,088
Serb-Croat-Slovene State	40	1,250	0	0
Irish Free State	1,123	6,155	582	2,707
Union of South Africa	0	0	89	2,019
Other countries	102	3,495	107	3,043
Total of swine	1,533	16,894	1,002	13,063

The Agricultural Index Number

THE customary rise which occurs in the general index figure for agricultural produce in January is apparent again this year in the rise from 46 per cent. above pre-war in December to 49 per cent. in January. The increase of 3 points this year is, however, less than the rises of 4 to 6 points shown in recent years. These increases are a result of prices in January of the base years being on the whole lower than those of December of those years.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1922:—

Month	Percentage Increase compared with the Average of the corresponding month in 1911-13					
	1922	1923	1924	1925	1926	1927
January	71	67	60	71	58	49
February	75	63	61	69	53	
March	73	59	57	66	49	
April	66	54	53	59	52	
May	69	54	57	57	50	
June	64	49	56	53	48	
July	67	50	53	49	48	
August.	68	52	57	54	49	
September	59	52	61	55	55	
October	61	50	66	53	48	
November	63	51	66	54	48	
December	61	55	65	54	46	

Grain

Wheat and oats showed no change in average price as compared with December, but, while the index figure for wheat remained unaltered at 61 per cent. above the base years 1911-13, the index figure for oats rose by 3 points to 20 per cent. above pre-war as a result of a lower base price in January. Barley at 10s. 11d. per cwt. was only 1d. per cwt. dearer than in December, but the index figure rose by 5 points to 36 per cent. above pre-war. Barley averaged 5d. per cwt. more than in January, 1926, but wheat was 5d. per cwt. cheaper and oats as much as 1s. 1d. per cwt. cheaper on the year.

Live Stock

The price of fat cattle in January was practically the same as in December, but, with a lower base price, the index figure was 5 points higher at 33 per cent. above the level of 1911-13. As compared with a year earlier, fat cattle were over 6s. per live cwt. cheaper. Fat sheep became a little dearer in the month under review and averaged 57 per cent. above pre-war, or 6 points lower than in January, 1926. Both bacon pigs and

porkers show higher index figures as compared with December, but the increases of 7 and 10 points respectively are due almost entirely to changes in base prices. Fat pigs were appreciably cheaper than in January, 1926, bacon pigs declining by 1s. 7d. and porkers by 11d. per stone during the twelve months. Dairy cattle depreciated in value in January by about 25s. per head, and were only 28 per cent. dearer than in 1911-13. Store cattle realized 29 per cent. and store sheep 55 per cent. above pre-war, while store pigs were very dear at 135 per cent. above January, 1911-13.

Dairy and Poultry Produce

The most noticeable price change as compared with December was that of eggs, which in January averaged only 1s. 10½d. per dozen, or 7d. per dozen less than in December, but as there was a proportional difference in the base years the index figure remained unaltered at the level of 46 per cent. above pre-war. This was a reduction of 24 points on the figure for the previous January, when eggs averaged about 2s. 2d. per dozen. Milk showed no change in price or index number. Butter was slightly cheaper and the relative index number was 3 points lower at 37 per cent. above 1911-13, while cheese, which became somewhat dearer, was 10 points higher at a level of 38 per cent. above the base years.

Other Commodities

Potatoes were very slightly cheaper in January, but the fall of 15 points in the index figure from 110 per cent. above the base years to 95 per cent. was due very largely to the higher base price in January, 1911-13.

Wool was a little cheaper on the month, but as prices in January, 1911-13, were lower than in December in those years, the index figure was 3 points higher at 32 per cent. above the pre-war level.

The reduction of 9 points in the general index number as compared with January, 1926, is due wholly to the lower level of prices of live stock and live-stock products. Corn, potatoes and hay averaged 39 per cent. above pre-war in January this year against 35 per cent. in January 1926, a rise of 4 points, mainly owing to the increased price of potatoes, but corn was only 3 points lower on the year. Fat stock showed a reduction of 14 points to an average of 52 per cent. above pre-war, and dairy produce declined by 11 points to an average of 61 per cent., while eggs and poultry at 42 per cent. above 1911-13 were 21 points lower on the year.

Index numbers of different commodities during recent months and in January, 1925 and 1926, are shown below :—

Percentage Increase as compared with the Average Prices ruling in the corresponding months of 1911-13

Commodity	1925	1926				1927
	Jan.	Jan.	Oct.	Nov.	Dec.	Jan.
Wheat	76	67	53	66	61	61
Barley	81	31	42	35	31	36
Oats	46	35	17	20	17	20
Fat cattle	52	52	35	31	28	33
Fat sheep	107	63	52	43	44	57
Bacon pigs	57	94	74	71	63	70
Pork pigs	59	94	81	76	72	82
Dairy cows	53	42	38	34	30	28
Store cattle	43	33	25	22	21	29
Store sheep	102	57	47	42	41	55
Store pigs	49	121	142	135	115	135
Eggs	82	70	68	60	46	46
Poultry	63	56	48	49	49	38
Milk	84	74	60	64	65	65
Butter	73	53	52	47	40	37
Cheese	49	82	30	28	28	38
Potatoes	152	53	81	113	110	95
Hay	1	4	6	4	2	—1*
Wool	128	50	32	31	29	32

* Decrease.

* * * * * *

Trials of Potatoes for Immunity from Wart Disease, 1926

THE trials which each year are held by the Ministry, with the object of testing new varieties of potatoes as to their immunity from wart disease, were again conducted in 1926 on the farm of the National Institute of Agricultural Botany, Ormskirk, Lancashire. The actual field operations and the taking of records were carried out by Mr. Harold Bryan, B.Sc., and Mrs. McDermott, of the Institute, but the trials were conducted on a plan approved by the Ministry.

The results of the trials have been considered by a small Committee composed of representatives of the Ministry of Agriculture, the Board of Agriculture for Scotland, and the Ministry of Agriculture for Northern Ireland, and co-ordinated with the results of the trials carried out by the two latter Departments at Philpstoun and Kilkeel respectively.

The Committee recommended the approval of no fewer than 39 new varieties, but only six of these have actually been added to the approved list. In the remaining cases, inclusion

has been postponed until such time as the raisers have intimated to the Ministry that the varieties have actually been, or will shortly be, introduced into commerce. Descriptions are given below of the six new approved varieties, together with those of four varieties which were approved after trials carried out in previous years, but which have only recently been placed on the market.

The findings of the Potato Synonym Committee of the National Institute of Agricultural Botany, have been accepted by the Ministry, where recommendations as to the classification of new varieties, as synomymous with existing varieties, have been made by that Committee.

Early Varieties :—

" *Earlyfield.*"

Sprout ..	Pink.
Tuber ..	Round to oval; skin white; flesh lemon; eyes shallow.
Haulm and Foliage	Dwarf, weak, spreading; leaflets grey-green, drooping, long, narrow, soft appearance; stem slight pink colouration at the base only; wings straight.
Flowers ..	White, large, not numerous.

" *Herald.*"

Sprout ..	Blue.
Tuber ..	Oval to oblong; skin white; eyes shallow; flesh white.
Haulm and Foliage	Low to medium height, spreading; leaves glossy.
Flowers ..	White, frequent; berries fairly frequent; buds dark.

Second Early Varieties :—

" *Argyll Favourite.*"

Sprout ..	Pink.
Tuber ..	Round; skin white; flesh white; eyes shallow, sub-terminal.
Haulm and Foliage	Upright to spreading; leaflets light grey-green, numerous small secondary leaflets; terminal leaflets drooping; wings serrated.
Flowers ..	White, fairly numerous, borne on long stalks.

" *Macbeth's Castle.*"

Sprout ..	Faint pink.
Tuber ..	Kidney; skin white; flesh white; eyes shallow.
Haulm and Foliage	Dwarf, spreading; leaflets rather small, grey-green colour; leaf markedly open.
Flowers ..	None observed.

Late or Maincrop Varieties :—

" *Aberdeen Favourite.*"

Sprout ..	Pink.
Tuber ..	Round; skin white; flesh pale lemon; eyes shallow.
Haulm and Foliage	Upright, compact; leaflets dark green, medium size, glossy, terminal leaflets drooping, secondary leaflets large; stems bronzed; wings straight.
Flowers ..	White, rare.

"*Cardinal.*"

Sprout ..	Deep red.
Tuber ..	Kidney; eyes shallow; skin very dark red; flesh white.
Haulm and Foliage	Tall, upright to spreading, moderately vigorous; leaflets light grey-green, smooth, dull and soft; stem colouration general, extending to the mid-ribs.
Flowers ..	Heliotrope, tipped white.

"*Doon Star.*"

Sprout ..	Purple.
Tuber ..	Round to oval; skin white; flesh lemon; eyes shallow.
Haulm and Foliage	Tall, strong, upright, compact, regular habit of growth; leaflets grey-green, erect, long, narrow, hard and dull appearance; stems bronzed, especially at base and in the axils of the leaves.
Flowers ..	White, not numerous; anthers orange.

"*Duke of Perth.*"

Sprout ..	Blue.
Tuber ..	Oval; skin white; eyes shallow; eyebrows long; flesh white.
Haulm and Foliage	Habit tall, upright, dense; stems strong, branching freely below ground, mottled dark red purple; wings waved at the tops; leaf fairly open, short; leaflets light to medium green, dull, soft.
Flowers ..	None observed.

"*Glencoe.*"

Sprout ..	Pink.
Tuber ..	Round to oval, flattish; skin white; flesh very pale lemon; eyes medium with faint pink colouration.
Haulm and Foliage	Upright, compact, vigorous, moderately tall; leaflets large, light grey-green.
Flowers ..	White, fairly numerous; anthers orange.

"*Hopeful.*"

Sprout ..	Pink.
Tuber ..	Round; skin white; flesh white; eyes medium.
Haulm and Foliage	Tall, strong, open, upright, with a tufted growing point; leaflets dark grey-green, long, fairly narrow; secondary leaflets large, few; stems green, thick; wings crinkled.
Flowers ..	White, large, numerous.

* * * * * *

Wart Disease Immunity Trials: Season 1927

THE Ministry will continue, during the coming season, to test, at Ormskirk, at the Potato Testing Station of the National Institute of Agricultural Botany, potatoes and potato seedlings as to their immunity from, or susceptibility to, wart disease, on the conditions stated below.

An entry form (No. 345 H.D.), obtainable from the Ministry, must be filled up and returned to the Potato Testing Station,

Lathom, Ormskirk, Lancs, *with the requisite fees.* Samples must be sent to the Station so as to arrive not earlier than February 21 or later than March 31, 1927.

Potatoes are accepted *from English, Scottish, and Irish growers*, for trial, under the following conditions :—

(*a*) Quantity of each stock of potato to be sent for the first time—35 seed-size tubers.

(*b*) Quantity of each stock of potato to be sent for the second and subsequent years—50 seed-size tubers.

Fees, on the following scale, are payable in respect of each stock of potato, when first entered for immunity trials :—

Less than five samples from one grower : 10s. per sample.

Five samples or more from one grower : 8s. per sample up to 20, and 6s. for each sample in excess of 20.

These fees are not returnable in any circumstances.

(*c*) The Ministry, while taking reasonable precautions to secure satisfactory growth, can accept no responsibility for the failure of any variety.

(*d*) The Ministry will take all reasonable precautions to secure that all the produce of the trial plots is fed to stock after being thoroughly mixed together, except such portions as may be needed for exhibition or scientific purposes authorized by the Ministry. The Ministry, however, reserves the right to send tubers from the produce grown at Ormskirk for testing at the official stations of the Board of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland.

(*e*) The Ministry will furnish as early as possible a report on each stock forwarded.

(*f*) When the Ministry is satisfied, as a result of the trials, that a variety is immune from wart disease, it will formally "approve" the variety and will issue an official certificate of immunity. Such certificates will not be issued until the variety has been named, and until an assurance has been received from the sender that it has been, or is about to be, introduced into commerce. *When a variety, tested under a number or letter, has been subsequently named and "approved," a sample of* 100 *tubers of the variety, as named, must be sent to Ormskirk for comparison with the tested stock.* No certificate will be issued for any new variety until it has passed at least two consecutive years' tests without contracting the disease, and has been declared by the Synonym Committee of the National Institute of Agricultural Botany to be distinct from existing varieties.

Potatoes are accepted *from foreign growers* on the conditions (*a*) to (*e*) set out above, but no foreign variety will be formally "approved" and no certificate will be issued until the variety is definitely introduced into commerce in Great Britain.

Trials of Seedlings.—The Ministry desires to encourage the breeding of new varieties of potatoes, and, in order to provide information for breeders of seedlings, it is prepared to accept not fewer than two tubers and not more than 10 tubers of any seedlings for growing for one season on the trial plots, and to furnish a report on the results obtained without payment of

a fee. These tests, however, will not be considered as forming part of the Immunity Trials proper and will not be reckoned in the minimum period of two years referred to under (*f*). The results of these tests will not be included in any report issued by the Ministry.

GENERAL INSTRUCTIONS: *Carriage*.—Small consignments should be sent by passenger train, carriage paid, or by parcel post; larger consignments should be forwarded by goods train, carriage paid.

Labels.—All consignments should be distinctly labelled. A label bearing the name and address of the sender and name of variety or seedling number should be firmly tied to the bag; in addition a similar label should be placed inside the bag.

Address.—All consignments should be addressed to:—

The Superintendent,
Potato Testing Station,
National Institute of Agricultural Botany,
Lathom, Ormskirk, Lancs.

Station: Ormskirk, L.M. & S. Railway.

Date of Forwarding.—Consignments should be sent so as to reach the Testing Station not earlier than February 21 nor later than March 31.

Foot-and-Mouth Disease.—Eleven outbreaks of foot-and-mouth disease have been confirmed since the issue of the February number of the JOURNAL.

Fresh centres of disease were discovered at Witney, Oxfordshire, on January 22; and at Kingsbury, Warwickshire, on February 10. Four other outbreaks have since been confirmed in the Warwickshire area.

In addition three further outbreaks have also been confirmed in the Duffield (Derby) district; and two in the Kelvedon (Essex) area.

Nineteen outbreaks have been confirmed in all since January 1 last, involving seven counties, and the slaughter of 773 cattle, 399 sheep and 325 pigs.

Farm Workers Minimum Wages.—A meeting of the Agricultural Wages Board was held on February 1, at 7 Whitehall Place, S.W. 1, the chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following orders carrying out the Committees' decisions.:—

Hampshire and Isle of Wight.—An Order, to come into operation on February 7, fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers, to continue in force until October 11, 1927. The minimum rate in the case of male workers of 21 years of age and over is increased from 30s. to 30s. 6d. per week of 51 hours in summer and 48 hours in winter, with overtime at 8d. per hour except in the case of carters, cowmen, shepherds or milkers, where the overtime rate in respect of time spent in attendance upon animals is 7½d. per hour. Slight increases are also made in the minimum rates for male workers of 18 and under 21 years of age. In the case of female workers of 18 years of age and over, the minimum rate is 5d. per hour for all time worked.

East Riding of Yorkshire.—An Order fixing special overtime rates of wages for employment on the corn harvest in 1927. The rates in question are in the case of male workers of 21 years of age and over, who are not boarded and lodged by their employer, 1s. 3d. per hour, and in the case of workers who are boarded and lodged, 1s.; in the case of foremen, beastmen, shepherds and waggoners, 9d. for third and fourth lads, and 7d. for other beginners irrespective of age.

Denbigh and Flint.—An Order continuing from February 16, 1927, until February 15, 1928, the existing minimum and overtime rates of wages for male and female workers. The minimum rates in the case of male workers of 21 years of age and over are 37s. per week of 61 hours in the case of horsemen, cattlemen, cowmen, shepherds or bailiffs, and 30s. 6d. per week of 50 hours in the case of other male workers, with overtime in all cases at 9d. per hour. The minimum rate fixed for female workers of 18 years of age and over is 5d. per hour, with overtime at 6½d. per hour.

Radnor and Brecon.—An Order fixing minimum and overtime rates of wages for male and female workers to come into operation on February 15, 1927, and to continue in operation until April 30, 1927. The minimum rates of wages are, in the case of male workers of 21 years of age and over, 30s. per week of 54 hours with overtime at 9d. per hour, and in the case of female workers of 18 years of age and over, 5d. per hour, with overtime at 6½d. per hour on weekdays and 7½d. per hour on Sundays.

Copies of the Orders in full may be obtained on application to the Secretary of the Agricultural Wages Board.

* * * * * *

Enforcement of Minimum Rates of Wages.—During the month ending February 15, legal proceedings were instituted against ten employers for failure to pay the minimum and overtime rates of wages fixed by the Orders of the Agricultural Wages Board for workers in agriculture. Particulars of the cases are as follows:—

County	Court	Fines £ s. d.	Costs £ s. d.	Arrears of wages £ s. d.	Workers concerned
Kent	Malling	10 0 0	0 10 6	23 8 8	2
Hants	Petersfield	16 0 0	5 5 0	100 0 0	4
Salop	Baschurch	—	2 9 0	18 4 0	1
"	Church Stretton	0 10 0	—	3 10 0	1
Durham	Staindrop	1 0 0	5 5 0	89 17 10	4
Glamorgan	Bridgend	2 0 0	1 19 0	2 10 0	3
"	Barry	4 0 0	0 14 6	15 11 0	2
Cornwall	Launceston	—	3 15 0	3 9 6	3
Kent	Wingham	2 0 0	—	14 15 10	2
Cornwall	Torpoint	3 0 0	3 18 0	5 7 3	3

The second annual report, required to be made by the Minister of Agriculture and Fisheries to Parliament, of proceedings under the Agricultural Wages (Regulation) Act, 1924, has now been issued, and copies are obtainable through any bookseller or directly from H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s.

The report reviews the work of the Agricultural Wages Board and the County Wages Committees during the twelve months ended September 30, 1926, and includes particulars of the minimum rates of wages in each area and information as to the steps taken by the Ministry to secure the observance of the rates.

Farm Wages in Scotland.—The Board of Agriculture for Scotland has published information as to the average wages paid to farm workers throughout Scotland at Martinmas, 1926.

The particulars given show a wide divergence in the wages paid in various parts of the country, and emphasize the prominent part which perquisites play in the contracts of employment in Scotland. In the case of grieves and foremen, cash wages vary between 47s. 6d. in Ayr (South) and 16s. 11d. in Inverness (Harris and Uist). The last-mentioned districts are not, however, the lowest paid areas when the values allotted to perquisites are added, the range in total remuneration being from 55s. 9d. in Dumbarton to 32s. 8d. in Sutherland. The value of the perquisites allowed to this class of workers varies between 17s. in Caithness and 1s. 2d. in Fife (S.W.) and Clackmannan.

The earnings of other classes of workers vary in much the same way, and the following table shows the highest and lowest figures for total remuneration of married and single workers :—

Class of workers	Highest total weekly remuneration		Lowest total weekly remuneration	
	County or district	Amount	County or district	Amount
Ploughmen :		s. d.		s. d.
Married	Argyll, Central	45 7	Orkney	27 0
Single	Forfar, N.E.	40 0	Dumfries	27 1
Cattlemen :				
Married	West Lothian	49 6	Caithness	32 0
Single	Perth, S.W.	37 1	Inverness (Harris and Uist)	26 4
Shepherds :				
Married	East Lothian	48 0	Ross (Lewis)	29 0
Single	Lanark, N.W.	39 0	Inverness (Harris and Uist)	27 1
Orramen :				
Married	Renfrew	42 0	Ross (Mainland)	28 6
Single	Aberdeen, E.	35 6	Inverness (Skye)	27 6

Leaflets issued by the Ministry.—Since the date of the list given in January (1927) issue of this JOURNAL, p. 968, the following leaflets have been issued :—

Rewritten :—
No. 356. Mole Draining.

Revised :—
No. 105. Wart Disease.
No. 170. The Use of Lime in Agriculture.

Amended :—
No. 332. Carnations.

International Yearbooks.—*The International Yearbook of Agricultural Statistics* for 1925-26 (xcviii + 560 pp. 8vo.) has been issued by the International Institute of Agriculture at Rome. The book, which is printed in French and English, includes every agricultural product reaching international markets, and provides an extensive

and lucid summary of statistical information for agriculture. The International Institute has also issued the *International Yearbook of Agricultural Legislation* for 1925 (1104 + xxxv pp. 8vo.) containing a record of laws, decrees and regulations relating to agriculture, enacted or issued in the various countries during that year. A brief analysis of the legislative measures, printed *in extenso* in the body of the volume, is given in the introduction, serving to direct the attention of the reader to the most important measures adopted by the different governments. Copies of both yearbooks can be obtained from the Ministry, on application to the Secretary at 10 Whitehall Place, S.W. 1. The price of the *Yearbook of Statistics* is 8s., and of the *Yearbook of Legislation*, 12s. 6d., both being sent post free in this country.

NOTICES OF BOOKS

Plant Nutrition and Crop Production. By E. J. Russell. (University of California Press and Cambridge University Press. Price 12s. 6d. net.)

This book embodies the Hitchcock Lectures for 1924, delivered by Sir John Russell at the University of California. The author describes in his clear, brief, inimitable style the achievements of scientific investigators from the early days when van Helmont demonstrated to his own satisfaction that water was the food of plants. Few experiments, as the author points out, show more clearly the need for caution in interpreting results. By the close of the eighteenth century the part played by the air in plant growth had been established, and de Saussure's masterly summary was published in 1804. There followed the method of exact field experiments, introduced by Boussingault in 1834, and thereafter progress was rapid. The year 1840 is described as the turning-point in the history of agricultural science. It was then that Liebig cleared up the old mysterious theory that plants could be nourished only by substances of like nature with his bold announcement that plants feed on simple mineral and gaseous substances and build them into highly complex products. Liebig's effort, however, to develop the practical aspects of the subject failed, and "it stands as a warning to the scientific investigator that laboratory results, however valuable in themselves, can rarely be translated directly into practice."

The importance of Liebig's work was recognized by Lawes, who by the discovery of superphosphate provided the first notable instance of the practical value of science to agriculture. Simultaneously, and in collaboration with Gilbert, he embarked on the extensive series of experiments in agricultural science now known all over the world as the Rothamsted experiments. Following this, we have a fascinating description of the discovery of various soil organisms during the period 1880-1890, "perhaps the most brilliant ten years in the history of soil science," culminating in a short account of the more recent study of soil bacteria and protozoa at Rothamsted itself.

Good progress has been made in the practical application of the latest knowledge of soil micro-organisms, although the work is still in its infancy. Partial sterilization of soils, as practised in the Lea Valley and elsewhere in connexion with glasshouse work, is the direct outcome of modern research; so also is the production of artificial farmyard manure—a method that may have important effects, both at home and abroad, where animals are not available for the conversion of straw and otherwise vegetable material into manure. The process consists of moistening straw with water and treating with ammonium carbonate,

being identical with manure making, except that the organisms derive their nitrogen from ammonium salts instead of animal excretions. Decomposition proceeds as in an ordinary dungheap, and bacterial activity is still further hastened by the addition of phosphates.

This sheds an interesting light on recent experiments on the intensive manuring of pastures with sulphate of ammonia in conjunction with phosphates and lime. It has been observed that densely matted, fibrous turf speedily decomposes under such treatment, giving way to rich, fine, palatable herbage.

Rothamsted is also responsible for an important advance in our knowledge of the life cycle of the nodular organism of lucerne. It was found to include both motile and non-motile forms, and that only in the motile condition could it invade the plant roots. Phosphates caused the organism to pass from the inert to the motile stage, and phosphates were accordingly added to the propagating fluid, thus ensuring a speedy commencement of motility after the culture is added to the soil.

The final chapter is devoted to the structure and composition of the soil—the mineral phase and the organic or energy phase—and the development of the population of living organisms therein. Considerable space is occupied by a study of the soil colloids, which is furnishing an explanation of many important soil properties which had previously been wholly inexplicable. The author shows conclusively that discoveries in applied science inevitably follow advances in pure science, and that exact knowledge is the only sure basis for improvement. It may be remarked in this connexion that the Director of Rothamsted is careful to ensure that the application is not delayed or overlooked through incomplete co-operation with the practical farmer.

A full discussion of the subject of plant nutrition, doubtless, lies beyond the power of any one man, just as in one small volume sketching the progress of agricultural science it is impossible to deal adequately even with the work at Rothamsted alone. Yet, as

> One grass blade in its veins
> Wisdom's whole flood contains,

one cannot but regret in closing the book that its accomplished author has not seen fit to expound some of the mysteries involved in the improvement of grass land.

The Scientific Feeding of Animals. By Professor O. Kellner. Authorized translation by W. Goodwin, M.Sc., Ph.D. (London: Duckworth & Co. Price 8s. 6d. net.)

The appearance, in 1909, of a translation of Kellner's Grundzüge der Fütterungslehre enabled many in England to apply, for the first time, scientific principles to the feeding of farm stock, and the *Scientific Feeding of Animals* became a standard text book in all countries where the English language was spoken. Since then the steady progress of Research in Animal Nutrition has resulted in the discovery of much new knowledge, so that in recent years a demand has arisen for a new edition of this book which should embody this knowledge, while eliminating material which no longer holds true. In the present book, a successful attempt has been made to satisfy this demand, and the translator has endeavoured, as far as possible, to preserve the character of the original book. For this reason no attempt has been made to rearrange the subject matter so as more fully to accord with English practice.

The subject matter of the book is grouped naturally into three parts. Part I deals with the composition, digestion and utilization of feeding stuffs; Part II is devoted to the consideration of the properties, conservation, preparation, and applicability of feeding stuffs;

and Part III treats of the feeding of domestic animals under conditions usually found in practice. New subject matter is included, the most important being a chapter on vitamins and a section dealing with the preparation of silage. The chapter on vitamins could with justification have been amplified to include some of the newer facts which have emerged comparatively recently, and perusal of this chapter leaves one with the impression that these substances have not received the full consideration that their importance merits. The section on silage is admirably written, and readers will welcome the newer knowledge it includes, particularly that dealing with the Herba ensilage process and the Schweizer electrical process.

A few minor faults are present which, although they do not detract from the value of the book, are none the less of importance. A tendency exists throughout the pages to regard the terms "foodstuffs" and "feeding stuffs" as synonymous, gastric lipase is given an importance it does not possess under normal conditions, and a few arithmetical errors which occur in the table of analyses in the first edition are also contained in this edition. The book may be recommended to all interested in animal nutrition, and both students and practitioners will derive information of much value to them in their respective vocations, since, in addition to a masterly exposition of the scientific principles of feeding, there exist, disseminated throughout the pages, pearls of practical wisdom.

ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Norris, W. J. C.—Life and Work on the Land. Practical Notes on Agriculture, Live Stock, Pastures, Estate Repairs, Bungalow Building, etc. (128 pp.) Northampton: W. Mark & Co.; London: Simpkin, Marshall, Hamilton, Kent & Co., 1926, 3s. 6d. [63.]

Turrentine, J. W.—Potash. A Review, Estimate and Forecast. (188 pp.) New York: John Wiley & Sons; London: Chapman & Hall, 1926, 15s. [63.1673.]

Adie, R. H.—Chemistry for Agricultural Students. (357 pp.) London: University Tutorial Press, 1926, 5s. 6d. [54.]

Klein, P., et Sanson, J.—Météorologie et Physique Agricoles. (464 pp.) [Encyclopédie Agricole.] Paris: J. B. Baillière et Fils, 1925, 10 francs. [551.5.]

Ministry of Agriculture and Fisheries.—Research and the Land: An account of recent progress in Agricultural and Horticultural Science in the United Kingdom. By *V. E. Wilkins.* (xiv+388 pp.) London: H.M. Stationery Office, 1926, 2s. 6d. paper covers; 3s. 6d. cloth. [37 (42); 37 (072).]

Farrow, E. P.—The Study of Vegetation. (23 pp.) London: Blackie & Son, 1926, 2s. [58.19 (42); 58.]

Tansley, A. G., and Chipp, T. F. (Edits.).—Aims and Methods in the Study of Vegetation. (xvi+384 pp.+19 pl.) London: The British Empire Vegetation Committee and The Crown Agents for the Colonies, 1926, 12s. 6d. [58; 58.3.]

Collins, S. Hoare, and Redington, G.—Plant Products. 2nd edition. (262 pp.) London: Baillière, Tindall & Cox, 1926, 10s. 6d. [54.]

Institute of Physics.—Physics in Industry, Vol. IV, Lecture No. 9. The Physicist in Agriculture with Special Reference to Soil Problems. By *B. A. Keen,* with a foreword by Sir Daniel Hall.

(pp. 27-63) Oxford: University Press; London: Humphrey Milford, 1926, 3s. [53; 63.112.]

Begtrup, H., Lund, H., and Manniche, E.—The Folk High-Schools of Denmark and the Development of a Farming Community, with an Introduction by Sir Michael Sadler. (168 pp.) Oxford: University Press; London: Humphrey Milford, 1926, 6s. [37 (489).]

Board of Agriculture for Scotland.—Miscellaneous Publication No. 6:—Agricultural Education and Research in Scotland. By *A. M'Cullam.* (88 pp.) Edinburgh, 1925, 1s. [37 (41).]

FitzRandolph, Helen E., and Hay, M. Doriel.—The Rural Industries of England and Wales. A survey made on behalf of the Agricultural Economics Research Institute, Oxford. Vol. I.—Timber and Underwood Industries and Some Village Workshops. (239 pp. + 12 pl.) Oxford: at the Clarendon Press, 1926, 5s. [63.193.]

Bruce, A. B., and Hunter, H.—Crop and Stock Improvement. ["Farmer and Stockbreeder" Manuals.] (117 pp.) London: Benn, 1926, 5s. [575.4.]

Russell, E. J.—Plant Nutrition and Crop Production. Hitchcock Lectures at the University of California, 1924. (ix + 115 pp. + 21 pl.) Berkeley: University of California Press; London: Cambridge University Press, 1926, 12s. 6d. [37 (01); 63.16; 63.161; 63.115.]

Ministry of Agriculture and Fisheries.—Power Alcohol Production, being a Report to the Minister of Agriculture and Fisheries of the Departmental Committee appointed by him in connexion with the Manufacture of Alcohol for Power Purposes from Sugar Beet. (14 pp.) London: H.M. Stationery Office, 1926, 6d. [663.5.]

Ministry of Agriculture and Fisheries.—Investigations into the Desiccation (De Vecchis) Process for Producing Sugar from Sugar Beet. Progress Report by *B. J. Owen.* (Oxford Institute of Agricultural Engineering.) (20 pp.) London: H.M. Stationery Office, 1926, 4d. [664.1.]

Empire Cotton Growing Corporation.—The Principles and Practice of Yield Trials. By *F. L. Engledow* and *G. Udny Yule.* (78 pp.) London: 1926, 2s. (post free). [37 (01); 63.34113.]

Field Crops

Salaman, R. N.—Potato Varieties. (400 pp. + 10 pl.) Cambridge: University Press, 1926, 25s. [63.512-194.]

Stewart, G.—Alfalfa Growing in the United States and Canada. (517 pp.) New York: Macmillan, 1926, 15s. [63.33 (c).]

Irish Free State Department of Lands and Agriculture.—Report on the Sugar Beet Experiments, 1925. (54 pp.) Dublin: Stationery Office, 1926. [63.3433 (415).]

Union of South Africa Board of Trade and Industries.—Report No. 67: Report on the Inquiry into the Methods and Costs of Wheat-growing and Milling. (29 pp.) Cape Town, 1926. [63.311; 31; 63.311 (68); 664.6.]

Horticulture

Sanders, T. W.—Fruit and its Cultivation. The Cultivation of all kinds of hardy fruits, including Planting, Pruning, Training and Propagation, Selections of Varieties, and Descriptions of Insect

and Fungoid Pests, with Remedies for their Eradication. (297 pp. + 44 pl.) London: W. H. & L. Collingridge, 1926 (Fourth Edition), 7s. 6d. [63.41.]

United States Department of Agriculture.—Department Bulletin No. 1406: The Ripening, Storage, and Handling of Apples. (64 pp.) Washington, 1926. [63.41 (a); 63.41-198.]

Dillistone, F. E.—Violet Culture: For Pleasure and Profit. (32 pp.) London: Benn, 1926, 2s. [63.522.]

Plant Pests and Diseases

Michigan Agricultural Experiment Station.—Technical Bulletin No. 76:—Concentration of Materials and Rates of Application in the Control of Apple Scab (*Venturia inaequalis.*). (18 pp.) East Lansing, 1926. [63.24.]

U.S. Department of Agriculture.—Farmers' Bulletin No. 1488:—Diseases of Raspberries and Blackberries. (33 pp.) Washington, 1926. [63.23-41; 63.24-41.]

Live Stock

Watson, J. A. S., Cameron, J., and Garrad, G. H.—The Cattle-Breeders' Handbook. ["Farmer and Stockbreeder" Manuals.] (144 pp.) London: Benn, 1926, 6s. [63.62.]

Morrison, Robert.—The Individuality of the Pig: Its Breeding, Feeding and Management. (377 pp. + 12 pl.) London: John Murray, 1926, 7s. 6d. [63.64]

Ministry of Agriculture and Fisheries.—Economic Series No. 12:—Report on the Marketing of Pigs in England and Wales. (103 pp. + 14 pl. + 10 diagrams.) London: H.M. Stationery Office, 1926, 6d. [63.6: 31; 63.64; 63.6: 38; 63.752.]

United States Department of Agriculture.—Farmers' Bulletin 1502:—Co-operative Live Stock Shipping Associations. (28 pp.) Washington, 1926. [334 (06); 63.6: 38.]

Porter, John.—The Stockfeeder's Companion. (2nd Edn. rev. and enl.) (xxiii + 364 pp. + 44 pl.) London: Gurney & Jackson, 1927, 7s. 6d. 63 6043

Kellner, O.—The Scientific Feeding of Animals. (2nd. Edition.) Translation by W. Goodwin of the 7th Edition of "Grundzüge der Fütterungslehre." (328 pp.) London: Duckworth, 1926, 8s. 6d. [612.394; 63.6043 (02).]

U.S. National Research Council.—Bulletin, Vol. II, Part I, No. 55.—The Determination of the Protein Requirements of Animals and of the Protein Values of Farm Feeds and Rations. Report of the Sub-committee on Animal Nutrition. By *H. H. Mitchell.* (44 pp.) Washington, 1926, $0.75. [612.394; 63.60433.]

Dairying

Garrad, G. H.—The Principles of Dairy-Farming. ["Farmer and Stockbreeder" Manuals.] (200 pp.) London: Benn, 1926, 7s. 6d. [63.711.]

Liversage, V.—Economics of Production of Grade "A" (Tuberculin-Tested) Milk. (58 pp.) Oxford: at the Clarendon Press, 1926, 2s. [63.714; 614.32.]

Thomson, G. Sutherland.—Testing Milk and Its Products. (83 pp.) London: Crosby Lockwood & Son, 1926, 4s. [63.712; 543.2.]

Irish Agricultural Organization Society.—Butter Control Scheme—A Creamery Survey. By *James Cullen.* (31 pp.) Dublin: 1926. [63.7 (415); 63.71; 614.32.]

United States Department of Commerce.—International Trade in Butter and Cheese. (51 pp.) Washington, 1926. 10 cents. [63.70: 38.]

Veterinary Science

Ministry of Agriculture and Fisheries.—Report of the Departmental Committee on Warble Fly Pest. (48 pp.) London: H.M. Stationery Office, 1926, 1s. 9d. [619.2 (f).]

Lander, G. D.—Veterinary Toxicology. (325 pp.) (Second Edition.) London: Baillière, Tindall & Cox, 1926, 12s. 6d. [619; 63.255.]

Cameron, T. W. M.—Diseases of Animals in Relation to Man. (222 pp.) London: Faber & Gwyer, 1926, 3s. 6d. [614; 619.]

Poultry

Ministry of Agriculture and Fisheries.—Economic Series No. 11:—Report on the Marketing of Poultry in England and Wales. (122 pp. + 28 pl. + 5 diagrams.) London: H.M. Stationery Office, 1926, 6d. [63.65 (42); 63.753.]

Maine Agricultural Experiment Station.—Bulletin No. 320:—The Influence of the Ultra-Violet Light on Nutrition in Poultry. (pp. 141-164 + 8 pl.) Orono, 1924. [612.394.]

Kentucky Agricultural Experiment Station.—Bulletin No. 260:—Sources of Animal Protein for Laying Hens.

I. Varying percentages of Meat Scrap in the Mash.
II. A comparison of Sour Skim Milk, condensed and dried Buttermilk with Meat Scrap.
III. Grain Supplements for Skim Milk.

(pp. 101-132.) Lexington, 1925. [63.651: 043.]

Economics

Robertson-Scott, J. W.—The Dying Peasant: and the Future of his Sons. (xiii + 232 pp.) London: Williams & Norgate, 1926, 10s. 6d. [331 (42); 331.2; 331.81.]

Ashby, A. W.—The Rural Standard of Living. (8 pp.) Cardiff: Welsh Housing and Development Association, 1926. [331 (42); 331.83.]

Gardiner, R. Strachan.—The Farmer's Guide to Ownership of Land. Hints for the Occupying Owner. (84 pp.) London: Central Landowners' Association, 1926, 3s. [347.]

A Labour Policy on Agriculture. (39 pp.) London: Trades Union Congress and The Labour Party, 1926, 2d. [333.5 (42); 338.1 (42).]

Ministry of Agriculture and Fisheries and Scottish Office.—Report of the Inter-Departmental Committee on Agricultural Unemployment Insurance. (107 pp.) London: H.M. Stationery Office, 1926, 6s. [368.4; 331.6.]

International Labour Office.—Studies and Reports, Series C, No. 10:—Unemployment Insurance. Study of Comparative Legislation. (134 pp.) Geneva, 1925, 2s. [368.4; 331.6.]

National Farmers' Union.—Report of a Committee of Investigation into the Co-operative Bacon Factory Industry appointed by the N.F.U. (72 pp.) London: N.F.U., 1926, 6d. [664.91; 63.752; 334 (42).]

Örne, Anders.—Co-operative Ideals and Problems. Translated from the Swedish by *J. Downie.* (xi + 143 pp.) Manchester: The Co-operative Union, 1926, 5s. [334.]

Dies, Edward Jerome.—Solving the Farm Riddle. (Outline of the Co-operative Movement in America, its Failures and Successes.) (147 pp.) Chicago: Pascal Covici, 1926, $1.50. [334 (73); 338.1 (73).]

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NOTE.—References to Insects and Fungi are indexed under the headings "Insects" and "Fungi" only, and to Diseases of Animals under "Diseases of Animals" only.

Editorial Notes are indexed under the subjects to which they refer.

To avoid confusion in reference, the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

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